CANADIAN INDUSTRY PROGRAM FOR ENERGY CONSERVATION

1987

89-00436/

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The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government's Ministers of Energy, Mines and Resources, Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives are to promote energy conservation by:

- Setting voluntary energy efficiency improvement goals.
- Reporting annually to government on issues and progress relative to achieving these goals.
- Increasing energy management awareness and techniques within industry.
- Exchanging non-proprietary energy information for common benefit.
- Maintaining effective industry-government dialogue.

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CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

W. Peter Torbet

August 12, 1988

The Honourable Marcel Masse, P.C., M.P.
Minister, Energy, Mines and Resources
House of Commons
Ottawa, Ontario
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Dear Minister,

This 1987 Report of the Canadian Industry Program for Energy Conservation shows continued excellent progress towards meeting our 1990 composite goal. While I am pleased to tell you of this success, I am saddened to report the death of our Chairman, Mr. Jeffrey Skelton, in March of this year. Jeff's contribution to the program was considerable and his leadership and counsel will be sadly missed.

Overall, industry's energy use per unit of output for 1987 was 28.4% less than the base year of 1973 and 2.6% less than 1986. In general, those Task Forces that have done particularly well this year are the ones where the strong economy has stimulated their business and raised capacities to very high levels of operating efficiency. Some Task Forces have already achieved their 1990 goals.

Your presence at our April Council meeting was most welcome and we regarded it as a strong endorsement of the CIPEC program. Also, the opportunity for me to outline our success story at your Energy Options Conference was very timely in view of the growing importance of energy conservation. At the conference, I emphasized the need for more practical information, such as the series of booklets on energy management developed by your Ministry, as one of the means of overcoming some of the major barriers to enhanced energy conservation. I also stressed that continued Industry/Government co-operation is essential if we are to achieve greater levels of success in future.

Looking ahead, we should meet our 1990 goal of 31% provided the economy stays strong, but any additional new rates of efficiency improvement will require much stronger efforts. In particular, solid support and encouragement of research and development is required, together with greater use of the best technologies and equipment used by our international competitors. This is essential for us to set ambitious new performance goals for 1995.

Governments have spent large sums of money on development of new energy supplies but comparatively little to help end-users achieve the levels of efficiency which are economically feasible. If we are to make faster progress, this imbalance must be corrected.

We further believe that Canada must not only develop all available sources of energy and use these sources wisely, but should also preserve the non-renewable resources as much as possible. This makes good sense for the people and future of Canada, and at the same time makes good economic sense to Canadian industry.

This inevitably brings up the issue of Free Trade with the United States. This is a matter which could have enormous impact on most industries. The nature and extent of that impact on energy use will differ in all Canadian industries. However, it is obvious that, while playing in a larger arena brings greater opportunities and challenges, the need for greater operating efficiencies becomes even more important for survival.

It is my pleasure as the new Chairman to pay tribute to the dedicated efforts of all those volunteers in the Task Forces, on the CIPEC Council, in the supporting Trade Associations, and especially, all the participating industrial companies that make this program such a notable success. As well, your staff in the Business and Government Energy Management Division deserve special recognition for their enthusiastic support. Without this co-operation, our achievements in this unique program would not be possible.

Yours sincerely,

W Peter Torbet

W.P. Torbet
Chairman, CIPEC Council

Energy at the Crossroads

1987 Performance

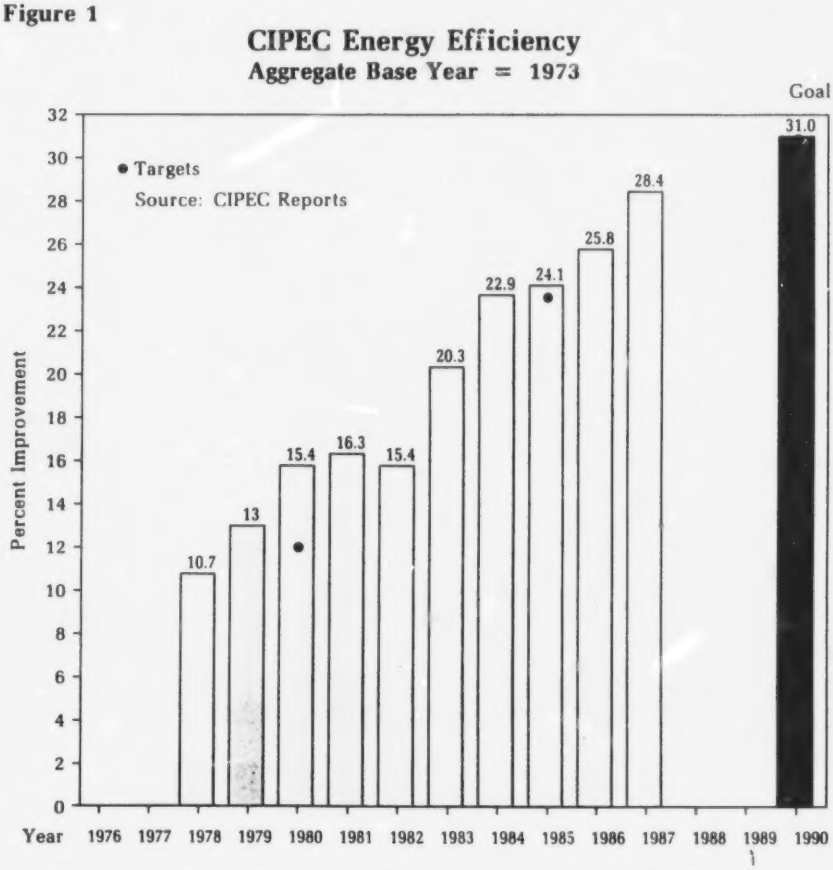
Canadian manufacturing and mining industries' energy efficiency improvement, as determined by a survey of 634 CIPEC participating companies, increased a buoyant 2.6% in 1987, raising the total increase to 28.4% over the original 1973 reference period. Compared with the new updated 1985 base year, efficiency has increased 4.3%. At this rate of increase, the 1990 goal of 31% should be achieved as planned.

Improvement in energy utilization is the result of many interdependent factors. In 1987, the bulk of the gains resulted from:

- Higher production levels
- Higher capacity utilization
- Higher profits and capital investment in the past few years
- Warmer weather.

While lower fuel oil and natural gas prices reduced some of the incentives to conserve, costs are again on the rise. Together with steadily increasing electrical prices, the need to offset energy cost increases with energy efficiency gains has again become a priority. CIPEC's historical performance, shown in Figure 1, exhibits an average improvement rate of 1.8% per year. While this overall performance incorporates various structural and product changes that have occurred throughout the participating industries, the higher 1987 gain suggests that companies have benefited from exceptionally good operating conditions this year.

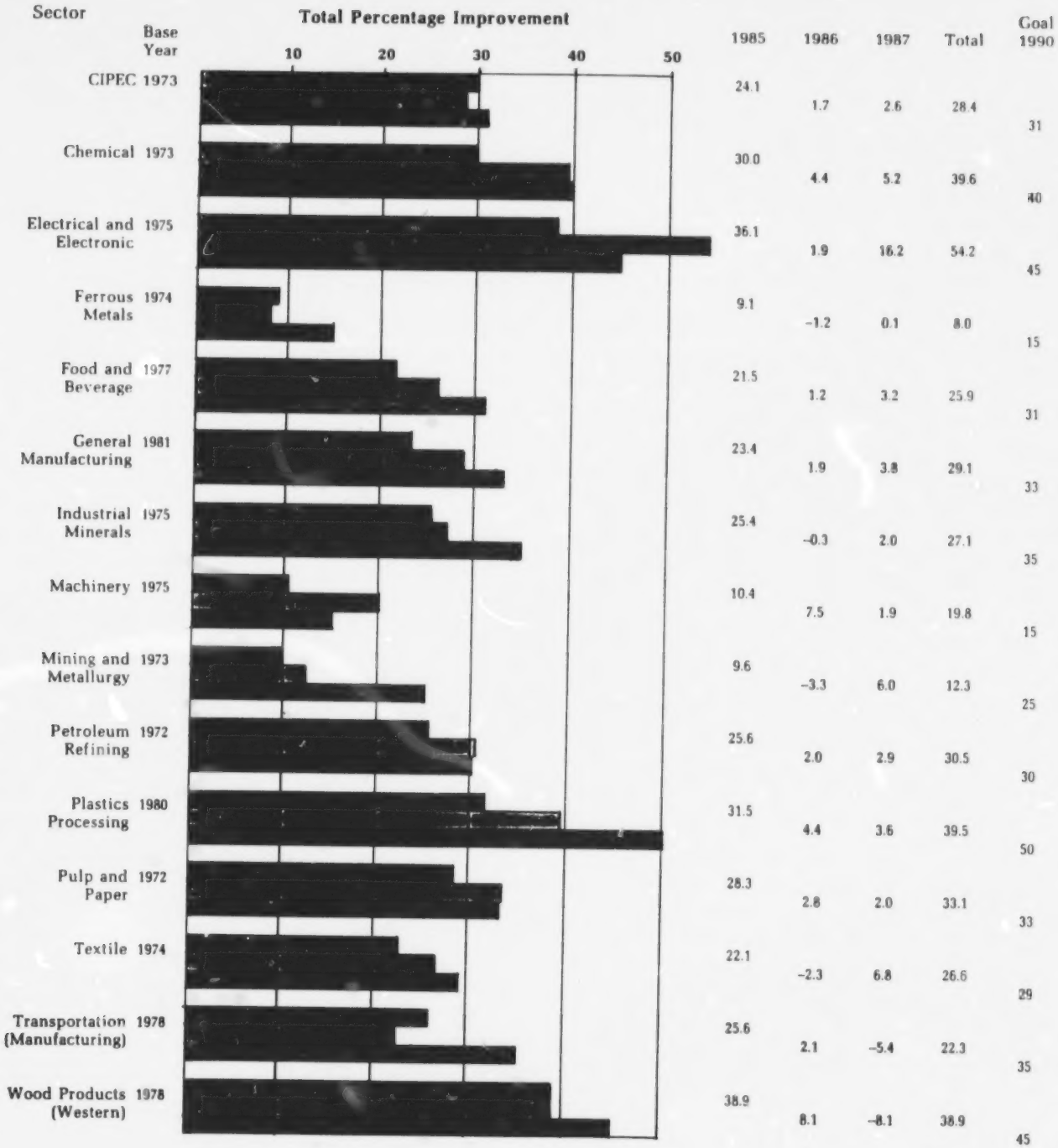
Figure 1



In Figure 2, the performance of each of the 14 sectors is displayed, together with their individual 1990 goals. It should be noted that each industry has vastly different energy intensities and potential for conservation; therefore, one should not be directly compared with another.

Figure 2

ENERGY INTENSITY IMPROVEMENT



Legend: ■ – Base Year to 1985
■ – Base Year to 1987
■ – 1990 Goal

Source: CIPEC Task Force Reports

Energy Consumption and Savings

The total amount of fuel and electricity used by the CIPEC participants in 1987 was 1451 petajoules, which is equivalent to the energy content of a 20-mile-long unit-train carrying crude oil delivered on a daily schedule, or, in electrical terms, equal to the output of 17 Ontario Hydro Bruce B nuclear stations delivering 3400 megawatts operating at 80% capacity.

This amount, supplied by the sources shown in Table I, represents about 61% of the 2395 petajoules of secondary[1] energy consumed by the total manufacturing and mining industries. Energy used as feedstocks is not included in the CIPEC survey since energy conservation was never intended to apply to these raw materials. Non-purchased waste hog fuel and pulping liquor used in the pulp and paper industry is also not included because of the difficulty of monitoring variable heat content and quantities used.

Table I

CIPEC Energy Consumption

Type	Quantity		Terajoules
Electricity	88,412,472	MWh	318,285
Natural Gas	12,882	million m^3	480,869
#2 Oil	274,713	kilolitres	10,885
#6 Oil	3,194,695	kilolitres	119,359
Propane	308,922	kilolitres	8,400
Diesel	249,988	kilolitres	9,974
Gasoline	15,957	kilolitres	577
Coal/Coke	6,403,467	tonnes	293,314
Steam	n/a		19,948
Others	n/a		189,969
Total			1,451,580

Source: Task Force Reports

[1] Secondary energy is defined as the end-use consumption after deductions are made for transmission losses, producers' own consumption (e.g. fuel used to generate electricity), and use in the non-energy sector, e.g. raw materials and feedstocks.

Table II

Energy Consumption, Costs, and Savings

	Energy Use (TJ)	Estimated Total Cost ($'000)	Accumulated Savings ($'000)	Annualized Savings ($'000)
Chemical [1]	250,170	1,133,898	741,832	32,021
Electrical and Electronic	6,690	47,172	55,823	2,231
Ferrous Metals	272,320	928,934	76,428	5,464
Food and Beverage	37,610	212,592	74,384	5,381
General Manufacturing	16,910	117,250	48,243	5,987
Industrial Minerals	91,260	433,702	161,351	10,289
Machinery	570	4,115	1,019	69
Mining and Metallurgy	133,150	782,248	109,638	6,929
Petroleum Refining [1]	267,000	590,839	259,289	12,263
Plastics Processing	2,090	16,439	10,718	982
Pulp and Paper	318,980	2,438,009	1,211,705	55,182
Textiles	9,280	62,885	22,789	1,313
Transportation (Manufacturing)	40,150	254,815	73,138	6,474
Wood Products (Western)	5,390	40,661	23,984	1,748
Total [2]	1,451,580	7,063,562	2,870,344	146,338

[1] All sectors' electrical conversion factors, including the Chemical and Petroleum Refining totals, are based on the standard 3600 kJ/kWh rate.

[2] Numbers may not add due to rounding.

Source: CIPEC Task Force Reports.

While industry remains the single largest consumer of energy, using 37.2% of the total 6213 petajoule secondary domestic demand, it uses less fuel oil than the transportation sector, residential and farming, and the commercial and institutional sectors.

The cost of fuel and electricity used during 1987 is estimated to be $7.06 billion (Table II). The 2.6% energy efficiency improvement of 1987 over 1986 results in an additional $146 million cost avoidance.

The total cost savings for 1987 over the original base year is $2.87 billion (28.4% improvement). The estimated cumulative savings for the program now totals $19 billion.

Energy Use Trends

CIPEC continues to monitor the energy consumption trends of its participants to determine where conservation actions are taking place and what forces are motivating changes.

Availability and price continue to be the major forces affecting energy shares. For example, the large shift to cheap coal in the Industrial Minerals sector and extension of the natural gas pipelines into Quebec helped that province's machinery and textiles companies make a dramatic shift away from unpredictably priced fuel oil. As well, the successful marketing of Quebec's low cost electricity also helped industries switch to electric-powered steam boilers.

Figure 3 shows that the changes in the sources of energy over time have mostly been in the reduction of fuel oil. Furthermore, Table III shows that not all sectors have substituted at the same rate because of the nature of their operations and/or access to alternatives.

CIPEC's reported energy consumption and end-uses are somewhat different from Statistics Canada's mainly because of differences in participation and inclusion of "other" fuels in the CIPEC survey.

Other differences arise from the fact that CIPEC companies tend to be the largest in their industries. Thus CIPEC shows greater use of waste fuels, coal and coke, and smaller shares of electricity than the broad mix of companies included in the Statistics Canada database.

CIPEC companies would therefore tend to have lower average energy costs and longer economic returns on energy conservation investments compared with industry as a whole.

Table III

Distribution of Energy Consumption (percentage)

	Nat. Gas and Propane					Liquid Petroleum Products					Electricity [1]					Coal and Coke					Others [2]				
	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75	87	86	85	80	75
Chemicals	50.1	48.6	51.2	54.4	57.1	2.1	3.0	4.3	14.1	24.3	32.0	31.0	27.9	24.2	17.3	0.6	0.5	0.1	2.3	–	15.2	16.9	16.5	5.0	1.3
Electrical	56.0	57.6	63.6	57.3	48.0	2.2	3.6	1.4	9.6	24.4	41.1	37.5	33.5	31.5	27.8	–	–	–	–	–	0.7	1.3	1.5	–	0.2
Ferrous Metals	19.6	19.7	19.4	18.9	15.4	5.1	4.6	4.2	10.5	13.2	7.6	7.6	7.3	5.9	5.4	67.7	68.1	69.1	64.6	68.6	–	–	–	–	0.3
Food and Bev.	69.2	69.5	69.7	64.8	48.5	9.9	10.8	11.7	20.6	38.5	20.8	19.4	18.6	14.6	12.8	–	–	–	–	–	0.1	0.3	–	–	0.2
General Mfg.	52.0	53.9	60.2	52.9	n/a	10.1	10.4	11.6	21.0	n/a	37.6	35.3	28.1	26.1	n/a	–	–	–	–	–	0.3	0.4	0.1	–	n/a
Ind. Minerals	42.7	40.1	42.6	43.1	50.6	6.6	6.9	8.7	26.1	33.1	15.5	15.7	15.6	15.8	10.3	34.0	36.6	32.4	14.3	5.8	1.2	0.7	0.7	0.1	0.1
Machinery	55.3	57.6	54.1	41.1	22.1	6.7	6.5	8.5	30.3	51.4	38.0	35.9	37.4	24.7	23.6	–	–	–	–	–	–	–	–	1.3	–
Mining	19.0	23.5	25.2	18.6	12.4	15.9	24.3	23.5	36.5	48.0	34.2	40.2	41.2	39.5	35.1	8.4	11.9	9.9	4.5	4.4	22.5	0.2	0.2	0.5	–
Petroleum	18.7	19.3	24.3	12.9	12.5	4.1	9.8	6.7	23.7	22.9	13.3	5.5	4.6	3.6	3.5	19.8	20.7	19.6	15.1	16.7	44.1	44.7	44.7	44.7	44.4
Plastics Proc.	47.6	53.4	51.4	63.5	43.5	2.9	4.2	5.4	3.1	31.9	49.5	42.5	43.2	33.4	23.7	–	–	–	–	–	–	–	–	–	–
Pulp & Paper	27.0	26.1	26.1	25.5	18.3	23.1	24.0	25.8	41.3	52.7	47.9	47.5	44.9	29.1	24.9	1.5	1.9	2.9	3.0	3.6	0.5	0.5	0.3	1.0	0.7
Textiles	55.4	55.1	55.0	27.2	29.1	8.1	8.1	15.8	49.1	49.9	36.6	36.6	29.1	22.0	20.1	–	–	–	–	–	0.3	0.2	0.1	1.7	0.9
Transport (Mfg.)	57.0	56.2	55.2	49.5	42.1	2.5	3.5	3.7	16.2	31.0	32.8	30.7	30.1	23.6	23.0	7.7	9.5	11.0	11.1	3.1	–	0.2	0.6	–	0.4
Wood Products	47.4	44.0	52.0	45.3	n/a	–	–	–	11.1	n/a	52.6	56.0	48.0	43.6	n/a	–	–	–	–	–	–	–	–	–	–
Totals	33.7	33.6	32.3	31.0	27.9	9.7	11.6	17.6	24.3	32.0	21.9	22.1	19.1	18.5	14.6	20.2	20.9	19.2	17.1	17.8	14.5	11.8	11.8	9.1	7.7

Footnotes:

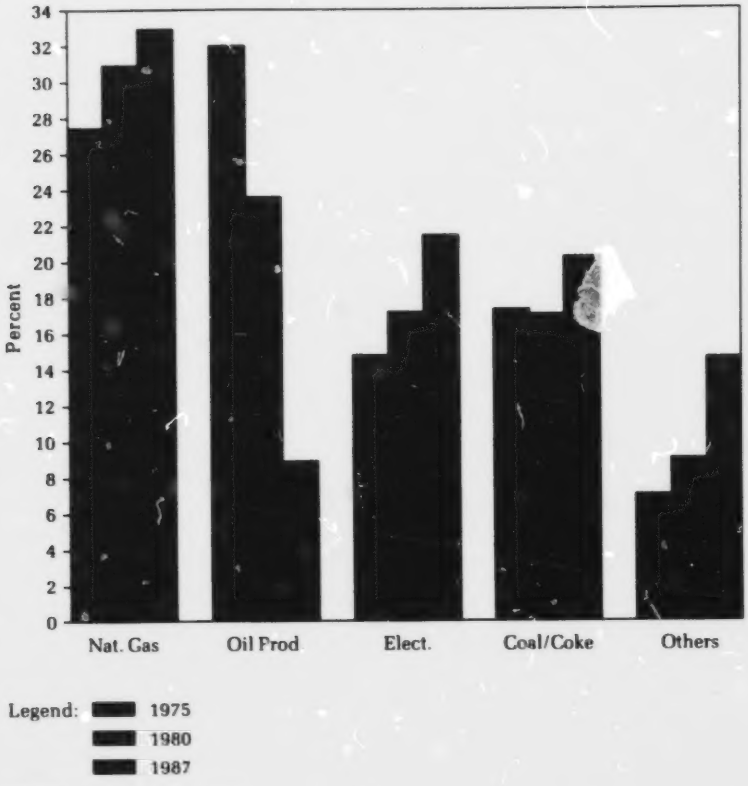
(1) All sectors' electricity converted at 3600 kJ/kWh.

(2) Other fuels include purchased steam, plant wastes, process by-products, miscellaneous fuels, but excludes wood wastes used in the Pulp and Paper and Wood Products sectors.

Source: CIPEC Task Force Reports.

Figure 3

CIPEC Distribution of Energy



Source: CIPEC Task Force Reports

Natural Gas

The CIPEC participants' trend toward greater use of natural gas came to a stand-still in 1987 at a market share of 33.7%.

In the five years prior to the introduction of deregulation in late 1985, CIPEC surveys showed a slow upward but steady 0.26% per year shift to natural gas. The quantity involved was equivalent to some 58,000 barrels of heavy oil per year.

In 1986 its market share spurted ahead 1.3% following moves to take advantage of the cheaper gas. It then held steady in 1987 when other fuels regained their competitive position.

Refined Petroleum Products

Consumption of fuel oil continues to decline at the steady rate of 2% per year. Since the beginning of CIPEC monitoring, the share of fuel oil has dropped from 32% to 9.7%. This means CIPEC participants now consume 52.9 million barrels per year less than they did in 1975.

The Ferrous Metal sector's minor increase is the result of a greater use of scrap (lower net production of raw steel) causing a percentage decline in the use of coke.

Even though there was no national or CIPEC goal set for reduction of oil consumption, the remaining 9.7% market share is thought to be very close to the practical bottom limit. Lower natural gas prices, the extension of the natural gas pipelines into Quebec, and assistance from the Federal Government's Oil Substitutior Program (now ended), motivated industry to switch to the more abundant natural gas fuel.

But many manufacturing companies still depend on fuel oil when there is no economic or supply alternative and for backup fuel. The possibility of co-combustion, i.e., fuel oil and coal, might slightly reduce oil consumption in eastern provinces where there are cheap indigenous coal supplies.

Electricity

The general shift towards greater consumption of electricity continues in all industries. Had it not been for the introduction of a huge tar sands plant into the reporting population in the Mining sector, the CIPEC electricity trend would have shown an increase again this year.

Previous increases in reported electrical consumption were due in part to Hydro-Quebec's very successful program for conversion of steam boilers from fuel oil to electric power. Quebec offered these incentives because of their large electric generating capacity and lack of indigenous fossil fuel. Pulp and Paper companies benefited most from this provincial program. Their consolidated electrical share rose from 24.9% in 1975 to 47.9% in 1987. As the result of similar incentives, the Textile industry's share increased from 20.1% to 36.6% for the same reason.

It is expected that total electrical consumption will increase about 2% to 3% per year because of a trend toward the greater electrification of factories and processes. For example, more extensive use of thermomechanical pulping (TMP), microwave drying systems, induction heating, etc., will continue to offer attractive technological and financial benefits.

Coal and Coke

The use of coal and coke in recent years has been limited because of its high environmental clean-up and transportation costs. Coal is used primarily in Ontario for electricity generation and in industries that manufacture steel and cement. The large quantity of coke used in the Petroleum Refining sector is actually a by-product that happens to be a cheap and ready source of fuel in that industry.

The Cement Manufacturing sector has been able to profitably increase its use, however, but even now this consumption is in decline because of price competition from natural gas.

A recent study[2] on the possible increased use of low-sulphur western Canadian coal identifies a number of major economic and environmental benefits that would help electrical generators (and industry) lower their manufacturing costs.

Others

The "other" category of fuels includes a diverse mix of wastes, process by-products, and miscellaneous fuels used mainly by the Chemical and Petroleum Refining industries. The huge amount of hog-fuel and pulping liquor used as fuel in the Pulp and Paper industry, as well as large quantities of hog-fuel used in the Wood Products industry, are not included in this category because of the difficulties of measuring heat content and quantities.

Occasionally, the use of these "wastes" change when their resale value exceeds their fuel value. Increased sale of by-product hydrogen is a recent example of this phenomenon.

[2] Report of a Federal/Provincial Task Force, "Western Canadian Low-Sulphur Coal", June 1986.

Even though many of these fuels are treated as cost-free sources of energy, industry has not taken full advantage of them. Technological problems associated with materials handling and combustion, as well as unpredictable supplies, have limited investment in many of these energy conservation opportunities.

Factors Affecting Performance

Industrial energy efficiency is affected by a number of distinct factors that can be classified to rank their impact on performance. Figure 4 shows the common factors most often identified in CIPEC task force reports.

Figure 4

Factors Affecting Energy Conservation

	Primary	Secondary
Direct	conservation projects retrofits housekeeping actions maintenance	process changes new technologies product changes corporate strategies operating procedures
Indirect	capacity utilization weather investment	energy prices government policies and programs tax regulations R&D information business competition

All the identified factors were initially grouped according to their direct/indirect and primary/secondary impact on results with subsequent consideration given to the effects of time, degree of management control over each factor, technological complexities involved, associated capital risks, and the influence of various incentives and market forces.

The resulting layout thus lends itself to several pertinent observations. For example, factors on the primary side are considered the foundation of energy conservation programs and represent the easiest actions to accomplish. When one hears "the easiest savings have been done" it usually infers that secondary factors are taking priority.

Direct factors have the most immediate long-lasting impact while indirect factors often have an uncertain and variable influence. Secondary factors represent more technologically complex and expensive action. Actions on the right side require more informed management attention than those simple primary items.

It is also evident that all the motivating factors are concentrated in the bottom right (secondary/indirect) corner. These are the driving

forces that initiate virtually all of the resulting actions. For example, R&D can lead to new technologies or process changes that result in retrofits to lessen the consumption and cost of energy.

In the early stages of CIPEC in the middle 1970's, strong motivational forces, i.e., rapidly rising energy prices, supportive government programs, favourable tax regulations (Class 34), etc., produced industrial efficiency gains of 2.5% per year.

In 1987, however, while most of the supporting motive forces were weak, the market-force (business competition) factor was the principal incentive contributing to energy efficiency improvement. But market-force actions have long-term effects and by themselves would not fully support the relatively high performance (2.6%) that occurred in 1987. It is therefore concluded that the bulk of the 1987 performance results came from primary/indirect causes, e.g., capacity utilization effects.

Industry's perception of energy conservation potentials, especially in view of current low oil prices, is another important motivating factor that can impact on performance.

Many studies have been done to analyze the causal factors affecting energy efficiency. For example, the American Gas Association[3] recently found three-quarters of U.S. industry's energy efficiency improvements came from primary factors while the remaining one-quarter was due to secondary factors. (In this study, many of the process changes and new technologies were classified as primary factors).

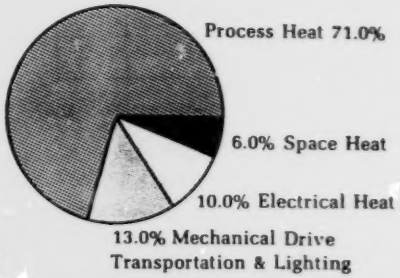
While the annual CIPEC-monitored results show the combined effects of all factors, some of the task forces, e.g., the Chemicals group, have attempted to identify the various reasons for improvements in their industry. The results are somewhat inconclusive however, because of the limited number of participants and large diversity of technologies and operations.

Other sources of information pointing to the individual ingredients contributing to energy efficiency come from the results of provincial auditing programs. In Ontario for example, over 33% of the recommendations involve process improvements. This is not surprising in view of the end-use of energy in Canadian industry, as shown in Figure 5. However, industry management is still very reluctant to tamper with their processes but seem more responsive to improvements in plant utility systems. In this area, the Ontario program auditors find 31.6% of their recommendations identify ways to use light oil more efficiently, 16.4% apply to the use of natural gas, 7.5% relate to electricity improvements and 7.4% of the suggestions deal with the use of heavy fuel oil. Improvement of combustion systems therefore still have the highest priority.

Also, in a recent study[4] done by EMR to examine the effects of low oil prices on energy conservation programs, it found the vast majority of projects using existing improvement technologies still provide acceptable economic paybacks of less than three years.

Figure 5

Industrial Sector
Energy End-Use



Source: Energy, Mines and Resources

Of 1,120 common industrial energy conservation retrofit projects based on current energy costs, those involving reduction of heavy fuel oil consumption were economically acceptable 90% of the time. Many of these projects cost less than $5,000.

Improvement projects involving natural gas were feasible 89% of the time.

Projects involving improved use of light fuel oil had an 80% chance of meeting the three-year payback criteria.

Common electrical retrofit projects also have a high "acceptability ratio" three-quarters of the time. This would suggest that, even though electrical prices are higher, the greater complexity and capital costs mean that improvements in this area will be more difficult to achieve. For this reason, the task facing Ontario Hydro in reducing the demand for its power will require strong supporting motivational factors, e.g., aggressive promotions, audits, grants, R&D, dissemination of information, etc.

Industry's perception of the necessity of conservation is also subtly affected by government's apparent emphasis on support of development of new supplies. Compared with expensive developments such as Hibernia and frontier resources at more than $22 per barrel, and the costs of construction and lifetime operation of new nuclear generating and fossil fuel stations at some $21 per barrel-equivalent, the "new resources" made available through conservation is still the most economic least-cost alternative. Energy conservation projects often cost less than $8 per barrel-equivalent to implement.

[3] American Gas Association, "En... Analysis", Arlington, Virginia, ... ary 22, 1988.

[4] "The Economics of Energy Conservation at Low World Oil Prices", Energy Policy and Coordination (PAC) Division, Energy Conservation Branch, EMR, June 1987.

Production Volume and Capacity Utilization

High production and capacity utilization levels were the only primary factors during 1987 that helped performance. As well, while many of the secondary factors were weak, those that did contribute to energy efficiency were the result of general productivity and expansion programs.

Capacity utilization levels (Figure 6) have varying effects on energy efficiency because most equipment and factories are designed to operate best at about three-quarters of their maximum capacity. This phenomenon was very noticeable in 1982 when production volumes slumped (Figure 7) and the efficiencies of energy use were consequently dragged down.

In 1987, many companies reported factory production at or above 100% of "name-plate" capacities. In these situations, the need to meet production schedules overrode the desire to operate the plants in the most efficient manner. Many companies also reported extensive debottlenecking activities to raise capacities even higher. A few mothballed plants were brought back into production to satisfy demand.

Since companies and industries usually find it necessary to expand when capacity utilizations exceed the 90% level, it appears several sectors are well into an expansion phase. The new and more efficient equipment now being installed will contribute to future efficiency gains.

Analysis of the effect capacity utilization has on individual plants becomes complicated when extended to total industry. One reason is that measurement of industrial capacity is done by different agencies that use different bases of comparison.

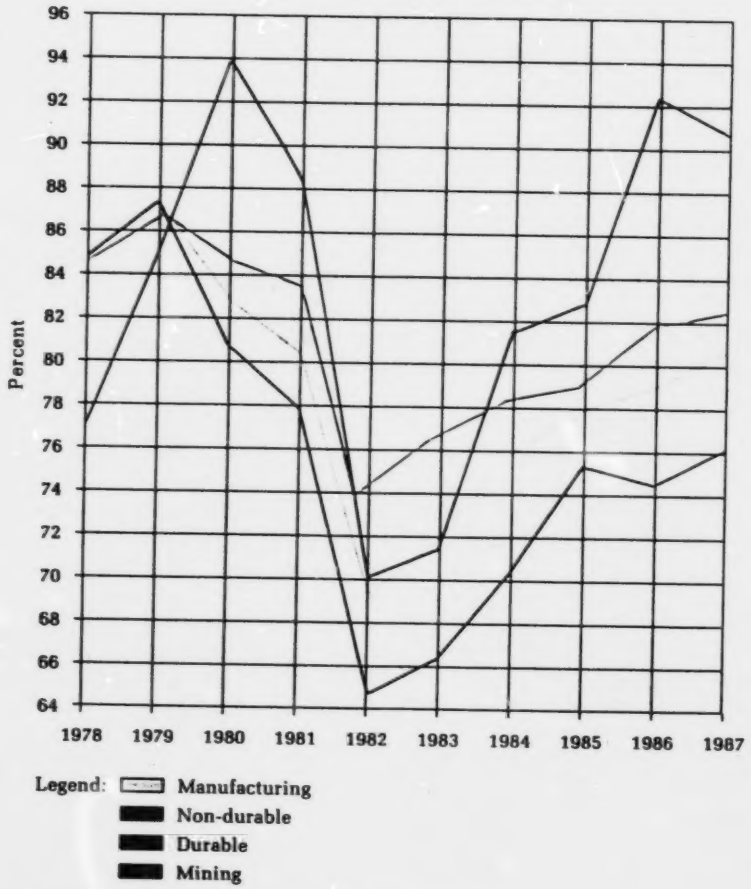
According to Statistics Canada, the Manufacturing Industry's capacity utilization rose 1.2% during 1987 up to the 80.3% level (Table IV). However, the Mining industry's trend declined 1.5% to 90.7% because of large investment in new facilities and equipment.

The annual impact of capacity utilization on energy efficiency is sometimes clearer when individual sector trends are examined. For example, the Electrical products sector energy efficiency gained 16 percentage points at the same time capacity utilization rose 7.6 points, while Transportation Manufacturing's efficiency dropped 5.4 points when capacity utilization went down 10 points during the year.

In addition, non-durable goods industries, e.g., Food and Beverage, Petroleum Refining, etc., have always displayed steadier capacity and efficiency patterns because of their low sensitivity to cyclical markets and hence their ability to operate at higher utilization rates. In contrast, durable goods industries, e.g., Electrical and Electronic and Wood Products, experience more volatile swings in capacity utilization and hence larger variations in energy efficiency.

Figure 6

Industrial Capacity Utilization



Source: CANSIM – Statistics Canada Cat. 31-003

Energy Prices

Perhaps the most important single factor impacting on performance is the effect of rising energy prices. Representative unit costs for each sector are shown in Table V.

The composite energy price, shown at the bottom of Table VI, resumed its upward direction again in 1987 after a brief dip in 1986. Electricity continues to be the highest priced source of energy.

Table V

Sector Average Energy Unit Costs

Sector	$/GJ
Chemical	4.53
Electrical and Electronic	7.05
Ferrous Metals	3.41
Food and Beverage	5.65
General Manufacturing	6.93
Industrial Minerals	4.75
Machinery	7.27
Mining and Metallurgy	7.49
Petroleum Refining	2.21
Plastics Processing	7.84
Pulp and Paper	7.64
Textiles	6.77
Transportation (Mfg.)	6.35
Wood Products (Western)	7.55
CIPEC average	4.87

Source: CIPEC Task Force Reports.

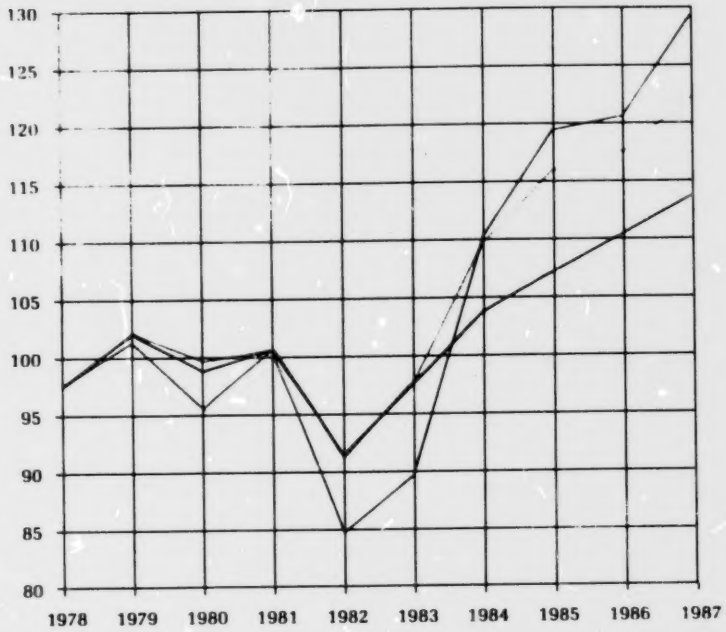
Unit costs vary among the provinces due to the methods of generation, fuels used, provincial taxes, and transmission costs. These factors not only result in the different average costs as shown, but also in different prices for the demand and energy components.

For example, large process type consumers (with high load and power factors) in each province would see an approximate demand to energy cost ratio of: 1/4.4 in Quebec, 1/3.8 Nova Scotia, 1/2.75 British Columbia, 1/2.2 New Brunswick, 1/1.9 Manitoba, 1/1.9 Saskatchewan, 1/1.6 Ontario, 1/1.4 Newfoundland, and 1/0.9 in Alberta.

Energy prices resumed their upward trend in 1987 after a minor decline resulting from the benefits of natural gas deregulation. This means the energy cost versus manufacturing expense ratio has resumed its upward trend and companies are again working harder to offset the increasing costs with improved operating efficiencies.

Figure 7

Industrial Production Index
(1981 = 100)



Source: CANSIM – Statistics Canada Cat. 61-005

Table IV

Capacity Utilizations

Sector	1985	1986	1987
Chemical	70.9	70.4	71.9
Electrical and Electronic	84.8	85.2	92.8
Ferrous Metals	72.1	69.9	74.2
Food and Beverage	81.1	80.6	78.4
	61.1	62.2	61.2
General Manufacturing	84.9	78.9	74.0
Industrial Minerals	68.6	73.7	80.3
Machinery	60.3	59.5	59.0
Mining and Metallurgy	82.7	92.2	90.7
Petroleum Refining	74.0	75.3	78.3
Plastics Processing	92.7	93.0	94.9
Pulp and Paper	85.4	89.4	91.7
Textiles	87.1	89.8	96.2
Transportation (Manufacturing)	78.6	72.6	62.6
Wood Products (Western)	85.6	82.7	90.9
Durable Goods Industries	75.5	74.6	76.1
Non-Durable Goods Industries	80.8	84.0	84.3
Total Manufacturing Industries	78.0	79.1	80.3

Source: CANSIM – Statistics Canada Cat. 31-003

Table VI

Average Industrial Energy Prices
(Current $/GJ)

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Nfld.	Elect. [1]	6.50	7.80	8.19	9.11	10.94	11.58	12.05	15.58	15.72	14.05
	Oil [2]	3.41	3.84	4.69	6.74	8.13	9.00	9.59	10.41	8.97	8.33
P.E.I.	Elect.	11.93	13.97	15.80	21.78	26.30	26.19	28.39	29.89	21.05	15.89
	Oil	3.41	3.84	4.64	6.56	7.95	8.64	9.23	9.92	8.49	8.28
N.S.	Elect.	7.78	8.89	9.33	9.33	9.33	11.56	12.03	12.03	13.00	13.31
	Oil	3.23	3.62	4.38	6.28	7.74	8.59	9.05	9.82	8.08	7.31
N.B.	Elect.	6.19	7.61	8.64	9.42	9.72	10.33	10.58	11.64	11.78	11.78
	Oil	3.26	3.67	4.36	6.31	7.74	8.59	9.21	9.95	8.79	8.46
Que.	Elect.	4.31	5.19	6.28	7.06	7.86	8.44	8.25	7.89	8.56	8.67
	Nat. Gas	2.15	2.28	2.63	3.32	4.33	4.63	4.96	4.63	4.65	4.58
	Oil	3.23	3.69	4.44	6.36	7.79	8.59	9.21	9.77	7.36	6.82
Ont.	Elect.	5.78	6.33	6.81	7.50	8.33	8.92	9.78	10.69	11.47	11.75
	Nat. Gas	1.94	2.10	2.41	3.07	3.80	4.25	4.25	4.22	4.10	3.75
	Oil	3.23	3.59	4.31	6.23	7.62	8.41	8.97	9.82	8.21	7.92
Man.	Elect.	4.69	5.53	5.58	5.58	5.67	6.06	6.56	6.92	7.00	7.69
	Nat. Gas	1.72	1.85	2.21	2.76	3.41	3.59	3.61	3.56	3.44	3.19
	Oil	3.10	3.49	4.28	6.23	7.54	8.56	9.10	9.87	8.92	7.97
Sask.	Elect.	6.19	6.86	7.64	8.36	9.58	10.39	11.92	12.53	13.33	14.31
	Nat. Gas	1.34	1.56	1.67	2.24	2.84	3.06	3.11	3.09	3.09	2.67
	Oil	3.13	3.49	4.26	6.21	7.59	8.33	8.90	9.64	7.72	7.44
Alta.	Elect.	3.97	4.86	5.28	6.14	6.83	7.92	9.00	8.89	8.81	8.81
	Nat. Gas	0.97	0.97	1.33	1.88	1.92	2.12	2.03	2.09	2.08	2.10
	Oil	–	–	–	–	–	–	–	–	–	–
B.C.	Elect.	3.42	3.75	4.50	5.56	6.86	7.61	8.31	8.61	8.75	8.75
	Nat. Gas	1.26	1.48	1.60	2.35	3.22	3.25	3.42	3.45	3.24	2.28
	Oil	3.28	3.67	4.36	6.28	7.64	8.44	8.92	9.69	8.10	7.51
CAN.	Elect.	4.83	5.58	6.36	7.17	8.14	8.83	9.31	9.69	10.17	10.28
	Nat. Gas	1.53	1.64	1.95	2.58	3.06	3.37	3.38	3.37	3.28	3.05
	Oil	3.21	3.62	4.38	6.31	7.72	8.54	9.10	9.82	7.92	7.46
Composite Price		2.70	2.96	3.44	4.47	5.36	5.77	6.09	6.43	5.97	6.13

[1] Monthly consumption 3.100 MWh (taxes included)
[2] Distillate Fuel Oil

Source: Energy, Mines & Resources Statistics Handbook

Profits and Capital Investments

The strong relationship between industry after-tax profit levels and CIPEC performance is shown in Figure 8. Based on the historical trends, future performance looks good.

In spite of the high level of profits in the past three years, operating budgets remain tight, but capital budgets have grown. General investment paybacks must be less than 3 years. The pattern of capital investment for the past five years is shown in Figure 9. The average payback of energy-related opportunities however, is 1.9 years, according to one major provincial auditing program impact report.

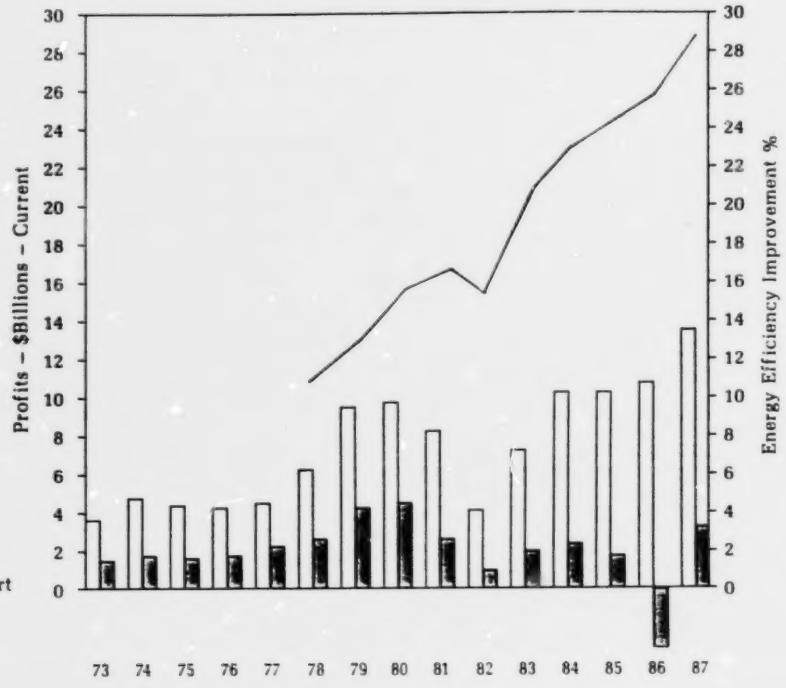
Where stand-alone retrofits were implemented, they were usually at locations of high-grade energy conversion, e.g., burners, heat exchangers, etc.

Industry has not yet exhausted the low-cost opportunities for energy savings. Provincial auditing programs are finding potential energy savings of 22% of total consumption with economic payback less than 3 years.

Figure 8

Manufacturing and Mining Profits (after tax)

With CIPEC Performance

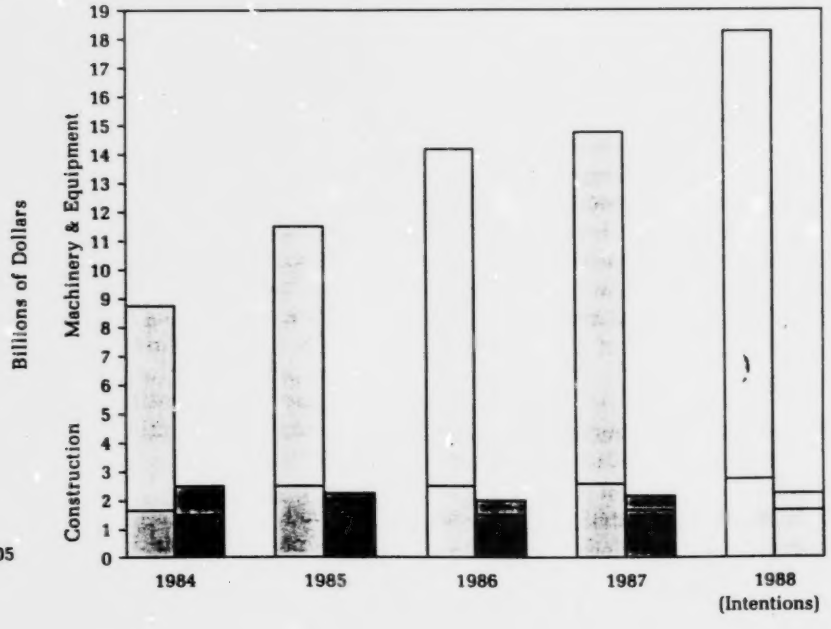


Legend: Manufacturing
Mining
CIPEC Performance

Source: Statistics Canada Cat. 13-001, CIPEC Report

Figure 9

Capital Expenditures



Legend: Manufacturing
Mining

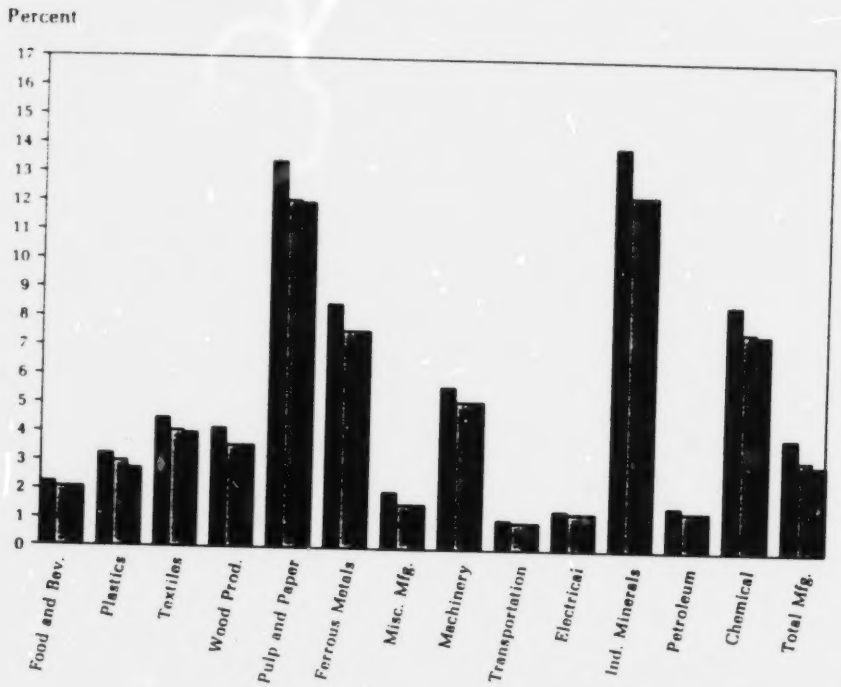
Source: CANSIM – Statistics Canada Cat. 61-205

Ratio of Energy to Manufacturing Expenses

The energy cost versus manufacturing expense ratio is an important indicator of how well corporate energy management programs are operating. While this ratio varies in individual firms depending on local prices and mix of energy, the general industry trends shown in Figure 10 indicate that ratios have improved in the last three years because of reduced natural gas and oil prices.

Figure 10

Energy Cost vs. Manufacturing Expense



Legend: 1985
1986
1987 Est.

Source: CANSIM – Statistics Canada

Reporting Population

Six hundred and thirty-four companies, with a combined total of some 1,000 different plants, submitted data for performance evaluation this year, representing 61% of Canadian industrial secondary energy consumption. This level of participation compares with 653 in 1986, 678 in 1985, 693 in 1984, 704 in 1983, 663 in 1982, and 683 in the pre-recession year of 1981.

The normal reporting turnover rate is a low 5%, indicating the high general commitment to the CIPEC program. This constant turnover rate depresses the real efficiency gains somewhat because new entries do not have the history nor the same level of savings comparable to those reported by regularly participating firms. Also, there is a trend toward entry of smaller companies which introduces a different energy mix and lower conservation potential. The main reasons usually offered for not participating in the surveys continue to be: extreme sensitivity to disclosure of operating information, difficulty in determining consistent units of production for meaningful comparison, and continued control over discretionary activities.

As well, some international companies control their performance monitoring functions from head office and choose not to respond to CIPEC surveys.

A few multinational companies have ceased manufacturing in Canada and have since turned their sites into warehousing operations. Others have been affected by "product mandating" strategies where new products have been introduced and historical performance data is not yet available.

Some participants find the up-to-date information useful for competitive evaluations and for corporate incentive and bonus programs. In these cases, the participants eagerly respond to the surveys knowing they will receive timely consolidated data in return.

Weather

Changes in weather conditions also had a noticeable effect on energy utilization during 1987, particularly in smaller and less energy-intensive companies. Of the CIPEC sectors, the least energy-intensive Electrical and Electronic industry, with large HVAC loads, will notice changes in energy consumption more readily than big consumers such as Pulp and Paper companies.

As shown in Table VII, heating requirements were again lower in all areas of the country — particularly in the western provinces. Normal temperatures are determined by the mean temperatures recorded between 1951 to 1980. Figures for 1985 are shown to coincide with the new CIPEC performance reference year.

The usual number of severe winter storms and power outages were reported in the Atlantic provinces, causing considerable inconvenience to industry. Central Canada recorded the warmest winter since 1958. In Ontario alone, light fuel oil consumption was down 27%, pulling the total distillate product group demand down by nearly 10%. The western provinces also recorded warmer than normal winter temperatures. Hot summer temperatures also added to air conditioning loads of many localities and helped set record electrical peak demand loads.

It has been estimated that warmer temperatures have reduced CIPEC participants' heating requirements, accounting for 2.8% of the energy efficiency improvement since 1973.

Table VII

Total Heating Degree-Days

(°C below 18°C)

City	Prov.	1987	1985	Normal	87 vs 85 %
Vancouver	B.C.	1084	1487	1234	−27
Calgary	Alta.	1840	2491	2181	−26
Edmonton	Alta.	1849	2502	2288	−26
Regina	Sask.	2021	2745	2325	−26
Winnipeg	Man.	1986	2683	2247	−26
London	Ont.	1426	1495	1499	− 5
Ottawa	Ont.	1718	1767	1746	− 3
Sudbury	Ont.	1945	2131	2057	− 9
Toronto	Ont.	1442	1506	1486	− 4
Montreal	Que.	1652	1695	1637	− 3
Quebec City	Que.	1961	1953	1910	0
Sherbrooke	Que.	1955	1969	2014	− 1
Fredericton	N.B.	1842	1915	1763	− 4
Halifax	N.S.	1508	1537	1407	− 2
Charlottetown	P.E.I.	1671	1743	1597	− 4
St. John's	Nfld.	1802	1943	1744	− 7

Source: Environment Canada

Federal Government Activities

Although CIPEC is primarily a private sector initiative, government has an important role to play. The Business and Government Energy Management Division (BGEM) of the Department of Energy, Mines and Resources (EMR) is responsible for administering government's participation in the CIPEC program.

The focus of government support is on activities and programs designed to assist all industrial sectors in finding solutions to their energy-related problems and in achieving their conservation goals.

Depending on individual requirements, financial and technical assistance is made available to the CIPEC Council, sector task forces, individual companies and trade associations for administration, research and development, special economic and technical studies.

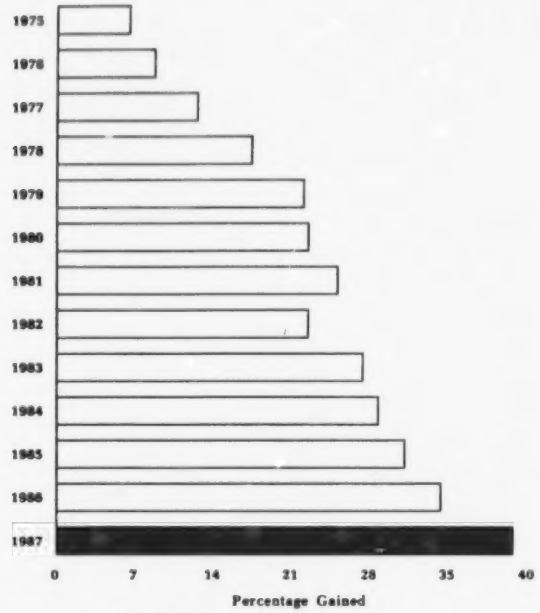
BGEM representatives assist with task force administration, attend council and task force meetings and help to develop practical "how-to" energy management conferences, workshops and seminars.

Close co-operation between government and the CIPEC network has brought significant benefit to both parties, and government has indicated that it wishes to build upon the success of the unique CIPEC partnership. As an example of this, EMR's proposed "Energy Efficiency and Diversity" initiative was outlined by their management to the CIPEC Council at its October meeting. The initiative proposes to place increased emphasis on support for the industrial and commercial sectors, particularly in the areas of research and development, information dissemination and technology transfer.

Chemical Industry

Energy Conservation Task Force

Dr. David Shearing
Chairman



General

The energy consumption and trends contained in this report are based on survey results of 46 member companies of The Canadian Chemical Producers' Association (CCPA). CCPA represents the chemical industry — located mainly in the provinces of Alberta, Ontario and Quebec — which produces a broad range of petrochemicals, inorganics and organic and specialty chemicals.

Although some chemical companies create products for sale at the consumer level, the vast majority make commodities and intermediates for other manufacturing industries. Thus, the productivity achieved in the chemical industry is a very significant determinant in the competitive strength of its downstream customers. Moreover, as a major upgrader of natural resources, a leader in the introduction and development of new technologies, and with an ever-increasing international orientation, this industry is a vital contributor to the economic wealth of the nation.

Energy management and conservation normally receive intense scrutiny throughout the chemical industry because of the high costs of feedstocks, fuel and electricity. In many petrochemical companies, these costs can amount to as much as 70% of total manufacturing expenses. In 1987, it is estimated that approximately $1,186 million was spent on fuel and electricity plus another $3.9 billion on feedstocks.

On the basis of fuel and electrical consumption, this survey accounts for approximately 61% of the total chemical industry's energy usage. The Canadian chemical industry uses approximately 24% of the total fuel and electricity consumed in the manufacturing industry.

1987 Performance

The participating companies improved their aggregated energy utilization by 5.2% during 1987. This result indicates that energy intensity has been lowered by 9.6% since the new 1985 base year level and 39.6% from the original 1973 reference year value. The industry has, therefore, achieved its 1990 goal of a 40% improvement three years ahead of schedule.

In the 1984 report, it was estimated that the weighted effects of new plant construction and general modernization accounted for 56% of the total improvement while implementation of major energy saving retrofits constituted 35%. Housekeeping and maintenance provided the remaining 9%.

Responses to similar questions in 1987 indicated that construction of new plants and revised processes still contribute the largest magnitude of savings, but housekeeping and maintenance are providing a growing contribution to the total results.

The 1987 aggregated results show that about 27% of the total efficiency gain to date can be attributed to new plant construction, new processes, and associated productivity improvements. It is estimated that this source of energy cost savings amounts to $883.8 million — after adjusting for annual price increases.

Benefits arising from upgraded process controls account for 25.9% of the total conservation achievement. This source of productivity improvement has generated accumulated savings of $880.4 million since 1973. The impact of improving process controls is growing because of rapid advances in technology. For example, some of the larger companies are beginning to use a forerunner of Artificial Intelligence (AI) in their processes by adapting database programs which anticipate short and long-term operating performance. By anticipating the changing effects of catalyst activity, weather, etc., optimum process conditions can be maintained over longer periods of time.

In the third category (specific energy retrofits and equipment modifications), the 1984 aggregate contribution of 35% has dropped slightly to 31.9% in 1987. This trend is not unexpected in view of the reduced number of economically viable retrofit projects and slower energy price increases. Some typical examples of notable projects follow to illustrate the current focus of energy conservation attention. Since the beginning of the task force performance monitoring in 1973, the accumulated energy cost savings due to upgraded retrofits amount to some $1,084.4 million.

The fourth category of housekeeping and maintenance improvements has increased from 9% in 1984 to 16% in 1987 giving rise to overall cost savings of $544.6 million since 1973. Only one of the surveyed companies indicated this category to be their only source of improvement. This category, by definition, includes activities such as on-line adjustments to machinery and controls, increasing heat transfer rates by hull blasting or chemical treatment, minimizing plant downtime, etc. Housekeeping and maintenance are always a reliable source of savings when other improvements are not possible.

There was no common pattern to the source of efficiency gains in individual companies. No doubt each result is based on a unique blend of technological and business factors. It is interesting to note, however, that companies showing the highest productivity have the ability to identify their energy efficiency sources in considerable detail and usually include in their report several examples of completed projects.

Examples of Plant Improvements

Maintenance of steam distribution and insulation systems continue to be mentioned as the most common low-cost way to save energy. Frequent comments about installation of new low-excess oxygen burners with more reliable controls indicate that efforts are being made to raise combustion efficiences. Other improvements in boilers and heaters involve techniques to maximize heat transfer in convection sections and recover blow-down waste heat. Tighter control of leakage from valves and machinery is another way to contain expensive process gases.

Analysis of processes and equipment, using "pinch technology" and other computerized modeiling techniques, is resulting in installations of additional heat exchangers and heat pumps. These new sophisticated analytical techniques are also being used to debottleneck plant processes.

Examples of process changes include comments from a chlorine producing company which is continuing a multimillion dollar upgrading program on its mercury cells. By replacing the manually adjusted graphite anodes with new stable metal anodes, cell resistance (K) factors are much lower and power requirements are greatly lessened. Another chemical firm reported large savings from the alteration of its filtration process, which results in less time for backwashing.

Companies also reported substantial efficiency gains from major alterations to machinery and equipment. For instance, one firm is now saving $223,000 per year from a $168,000 mechanical alteration to one of its older steam turbines. Another company reported that its 1986 investment of $16 million for replacement of two large steam turbines with two 17-megawatt variable speed electric drives is expected to save up to $11 million per year.

Energy Consumption Patterns

The industry's changes in energy consumption continue to display the effects of several short and long-term trends. Annual shifts are caused by fuel price competition, changes in processes and completion of retrofits, and start-up of new plants.

Long-term shifts, however, are influenced by fuel substitution incentive programs, energy conservation efforts, technological advances in processes and equipment, and compositional changes in the industry.

The most noticeable short-term change has been a 2% share increase in natural gas compared with 1986, at the expense of a 1.6% drop in heavy fuel oil, mainly as a result of deregulated natural gas prices. The gain of 1% in electricity's share reflects business growth in the electrochemical sector.

The chemical industry is continuing to recover by-products and wastes for use as secondary fuels. However, in 1987 the respondents reported that more of these wastes were being upgraded for sale which lowered its share from 14.7 to 13%.

Chemical Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		317.133 petajoules
New base year (1985) equivalent energy inputs		350.309 petajoules
Gross Improvement = 9.5%		
Adjustments (environmental)		0.500 petajoules
Adjusted base year equivalent		350.809 petajoules
Net Improvement = 9.6%		
Efficiency gain 1973 - 1985	30.0	
1986	4.4	
1987	5.2	
Total gain 1973 - 1987	39.6%	

Chemical Industry
Energy Use

Type	Units	Petajoules	Percentage of Total Consumed 1987	1986	1985
Natural Gas	4,185,953,000 m^3	155.717	49.1	47.1	53.0
Electricity	9,629,555 MWh	101.601	32.0	31.0	24.2
Liquid Petroleum Products					
Distillate Oil	92,916 m^3	3.796	1.2	0.5	2.9
Residual Oil	68,123 m^3	2.784	0.8	2.4	11.0
Diesel and Gasoline	4,272 m^3	0.170	0.1	0.1	0.2
Propane, LPG	113,990 m^3	3.092	1.0	1.5	1.4
Coal and Coke	56,210 tonnes	1.698	0.6	0.5	2.3
Other Fuels	n/a	41.285	13.0	14.7	4.0
Steam	n/a	6.990	2.2	2.2	1.0
Total		317.133			

Electricity is converted at 10,551 kJ/kWh
Other fuels include process by-products, vent gases, drips, slops, pitch, sulphur, hydrogen, waste oils, etc.

By-product hydrogen is now more valuable as a saleable commodity than as a fuel and is largely responsible for the reduced use of waste.

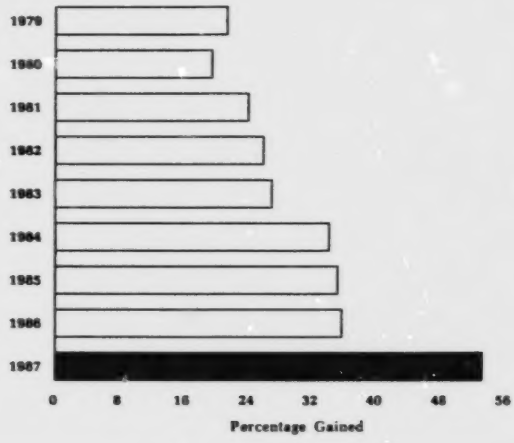
The industry's long-term (1980-1987) trends in energy consumption show a 10.2% drop in heavy fuel oil, a 9% gain in use of wastes and a 7.8% gain in electricity. While these trends show the effects of the "off-oil" substitution program and energy conservation, the gain in electricity share reflects the changes in the reporting population where, in 1987, fewer of the petrochemical companies participated in the survey.

The possibility of further fuel switching is remote as companies have taken full advantage of substitution programs and price incentives.

Electrical and Electronic Industry

Energy Conservation Task Force

Seth Duffus
Chairman



A Banner Year

Significant productivity improvements, new manufacturing techniques and improved survey reporting are among the many factors that helped the electrical and electronic industry post a record 16.2% improvement in energy efficiency in 1987.

This represents the greatest one year energy improvement in the sector since the base year 1975, and brings total efficiency improvements since that base year to 54%. A measure of the Electrical and Electronic Industry Task Force's success is the fact that it has exceeded its 1990 target of a 45% improvement in energy efficiency over the base year a full three years early.

The significant improvements in energy efficiency reflect that 1987 was a banner year for the electrical and electronic industry. Manufacturing activity grew between 7% and 8%. Capacity utilization, which recently hovered in the 60 to 70% range, topped 80% in 1987. The result for many companies was a substantial increase in productivity — and energy productivity improvements that in some cases were as high as 30 and 40% for 1987 alone.

The Sector

The more than 150 companies represented by this task force manufacture a diverse range of products used in the generation, transmission and distribution of electricity. These include generators, transformers, switchgear, lighting equipment, wire and cable and electrical appliances, as well as a host of electronic products and systems and related high technology components. Most of the companies are members of the Electrical and Electronic Manufacturers Association of Canada (EEMAC) which acts as a secretariat for the task force.

Productivity Gains and Energy Use

As indicated earlier, a major factor in the 16.2% increase in energy efficiency in 1987 was an improved productivity picture. Better use of installed capacity combined with a continued commitment to a "lean and mean" business philosophy paid off on the energy front: output/overhead ratios improved, resulting in significant increases in energy efficiency. Specifically, the following factors contributed to the sector's energy results.

- Automation, computerization and robotics: The introduction of new technologies such as CAD/CAM and programmable controllers continued to affect the energy picture. On the one hand, they helped reduce labour costs and improve output, thus contributing to improved energy efficiency. As well, increased automation and computerization

prompted a noticeable shift in consumption to electricity; of all the energy sources, electricity alone has posted a steady increase in consumption since 1979, while oil and gas use has declined. (In 1979, electricity accounted for 30% of energy used by the sector, compared with 41% in 1987.)

- Product rationalization: To be competitive globally, more and more companies in the sector are rationalizing and upgrading processes to produce a limited number of specific products (in some cases, only one product) for world markets, where once they might have manufactured a diverse product line for much smaller markets. Resulting productivity gains are reflected in improved energy efficiency.

- New process design: As energy costs become a concern at all levels of plant engineering, energy conservation has become part of process design. Products are made with newer, lighter materials, require less manufacturing time to produce and often are more energy efficient operationally. Thus there are energy payoffs on several fronts.

Task Force Activities

In addition to offering two more of the successful technology transfer workshops on "Heating, Ventilating and Air Conditioning," the task force last year organized a series of plant tours designed to give sector members first hand insights into innovative and successful energy management practices used by its members.

More importantly, the task force began the process of reassessing its role and future in an era when energy conservation is seemingly low on many companies' priority lists. To this end, a questionnaire was sent to all members and a followup brainstorming session held to discuss members' views. Mr. Bev Markle, a former task force chairman, was retained as a consultant to simplify the energy management survey form and examine ways of increasing participation in task force activities. The increase in the number of companies participating in the survey to 45 in 1987 from 34 the previous year is testimony to his success.

The Year Ahead

Although gratifying, the sector's 1987 energy efficiency improvements are unlikely to be repeated in 1988: even if manufacturing activity continues at its present pace, most companies will be able to squeeze only marginal productivity improvements out of their operations.

The challenge for the task force is to help industries discover new opportunities to conserve energy — a task it is well positioned to undertake as the electrical and electronic sector is both a producer and user of equipment designed to help companies conserve energy.

A major opportunity, for example, lies in the area of environmental control: heating and air conditioning systems consume 48% of energy used by industry, yet are among the most poorly maintained systems in many operations. The technology exists — in the form of microprocessors, programmable controllers and similar equipment manufactured by companies in the electrical and electronic sector — to not only substantially reduce energy costs, but also make energy management easier.

The task force's job, in 1988 and beyond, will be to encourage plant engineering staff in all industries to use the state-of-the-art equipment available to them to better manage their energy resources, and to help them with the data reporting so as to accurately present the sector's performance.

Electrical and Electronic Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		6,689,830 gigajoules
New base year (1986) equivalent energy inputs		7,981,429 gigajoules
Net Improvement = 16.2%		
Adjustments — None		
Efficiency gain 1975 - 1985	36.1	
1986	1.9	
1987	16.2	
Total gain 1975 - 1987	54.2%	

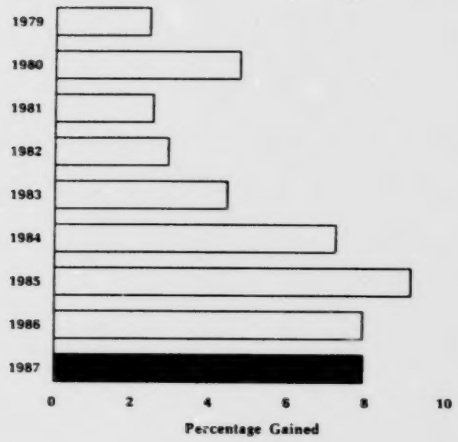
Electrical and Electronic Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1987	1986	1985
Natural Gas	98,477,397 m^3	3,663,362	54.8	57.3	59.6
Electricity	763,441 MWh	2,748,388	41.1	37.5	33.5
Liquid Petroleum Products					
Distillate Oil	1,566 kilolitres	61,064	0.9	1.4	0.6
Residual Oil	2,058 kilolitres	83,353	1.2	1.8	0.7
Diesel and Gasoline	249 kilolitres	9,570	0.1	0.4	0.1
Other Fuels					
Propane	3,006 kilolitres	80,126	1.2	0.3	4.0
Steam	24,836,431 kilograms	43,967	0.7	1.3	1.5
Totals 1987		6,689,830			
1986		5,806,412			
1985		5,841,065			
1984		8,778,400			
1983		8,886,142			
1982		8,718,000			

Ferrous Metals Industry

Energy Conservation Task Force

Don W.R. George
Chairman



Task Force Description

The Ferrous Metals Industry Energy Conservation Task Force is represented by the steelmakers who comprise the Ferrous Industry Energy Research Association (FERA). The companies which provided data for the 1987 energy efficiency assessment include:

- Algoma Steel Corporation
- Dofasco Inc.
- Sidbec-Dosco Inc.
- Stelco Inc.
- Sydney Steel Corporation (Sysco)

Together, these companies represent about 85% of the total Canadian raw steel production and produce steel by the following techniques:

- blast furnace, basic oxygen and/or open hearth process
- direct reduction/electric furnace
- electric steelmaking furnace

A partial listing of steel products would include:

- structural shapes
- rails
- flat rolled products
- forgings
- fasteners
- coated steel
- castings
- tubular products
- bar products
- wire and wire products

Steel is produced and/or processed at 33 plants among the member companies.

1987 Composite Energy Performance

Steel production increased in 1987 to 11,856,731 tonnes from 11,594,290 tonnes in 1986 — an increase of 2.3%.

The amount of energy consumed per tonne of raw steel was marginally lower in 1987 at 22.87 x 10^9 Joules, compared with 1986 at 22.90 x 10^9 Joules (a decrease of 0.1%).

All participating companies achieved success in their plant energy conservation programs, with a number of these achievements listed at the end of this report. However, certain factors overshadowed the conservation achievements in 1987 and resulted in little change in the composite energy rate. Some of these negative factors include:

- Reduced scrap proportions in the steelmaking process.
- Interruptions to the normal operating pace due to major construction projects and breakdowns.
- A shift towards more energy intensive products.

Progress Towards the 1990 Energy Rate Goal

In 1987, the energy rate at 22.87 x 10^9 Joules/tonne was 1.1% higher than the new base year of 1985, and is 9.4% higher than the energy goal in 1990 of 20.91 x 10^9 Joules/tonne.

Task Force Technical Activities

The FERA Technical Committee continued to foster activities geared to assisting member companies improve their energy performance.

In the main committee:

- A new format was developed for documenting and exchanging case studies on member company energy conservation achievements, and 11 were exchanged.
- Technical discussions were held on flue gas oxygen measurement, and by-product fuel dispatching.
- A list of potential joint projects was reviewed and two (electric speed control, and industrial heat pumps) were selected for further expansion.

A Steam Conservation Workshop was held in September 1987 in Burlington, Ontario. This was co-sponsored with Energy, Mines and Resources (EMR) and attracted 39 participants and speakers from the four member companies with major steam systems.

At FERA's request, EMR also hosted a tour of the Combustion and Carbonization Research Laboratory (CCRL), followed by presentations on coal-water fuels, plasma technology applications, and industrial flue gas condensing boilers.

FERA continued to monitor developments of the International Flame Research Foundation (IFRF) through a designated representative who, in 1987, attended two meetings of the American Flame Research Committee (AFRC). FERA is making plans to host the Spring meeting of this committee in Toronto in May 1988.

Conservation Projects for 1988

All participating companies expect to implement energy saving measures in 1988. A sampling of the more significant items include:

- Extension of preheat tunnels on galvanizing lines to reduce the fuel rate.
- Redesign of slab reheat furnace to increase capacity and fuel efficiency.
- Addition of automated hinged lids on steelmaking vessels.
- Modification of plant equipment and practices to better utilize internally generated fuels.

1987 Energy Conservation Achievements

The following is a partial listing of energy conservation achievements by task force members in 1987.

New Energy Efficient Installations

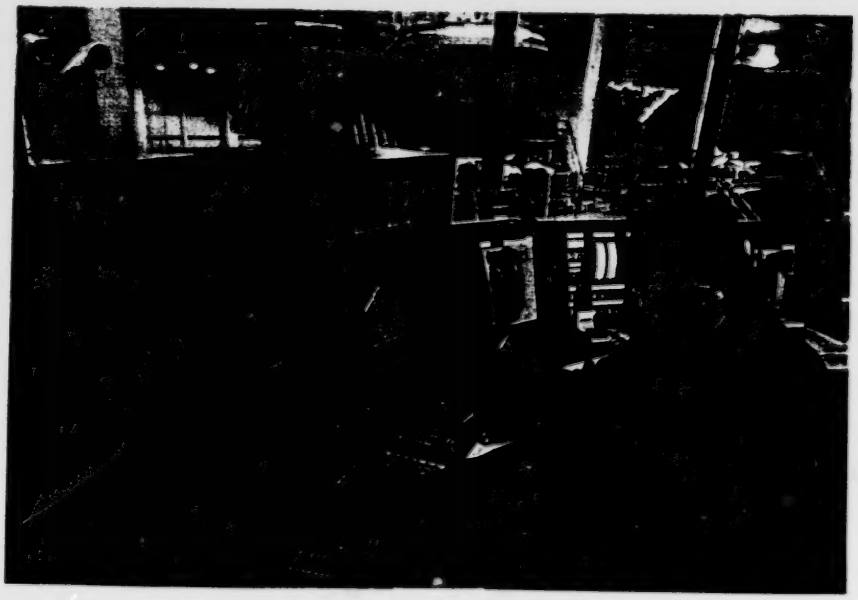
- Two new slab reheat furnaces with unfired preheat zone, 1200°F combustion air preheat, computer control, upgraded insulation and steam recovery from evaporative skid cooling.
- Start-up of two new slab casters which eliminate the energy use in heating and rolling ingots into slabs.
- Start-up of new seamless tube mill, complete with full computer control and efficient reheat furnaces.

Modifications to Existing Equipment

- Modifications to rail mill and slab furnaces to improve insulation and reduce air filtration.
- Replacement of conventional burners on rail mill furnaces with 100% oxygen enriched burners.
- Rebuild of boiler feedwater system to improve the boiler house steam balance and eliminate exhaust steam venting.
- Refurbished coke oven battery to burn surplus blast furnace gas.

Operating Changes

- Better scheduling of by-product fuel users to reduce flaring.
- Increased steam production on boilers with the highest efficiency rating.



- Modified the fuel firing on blast furnace stoves to ensure a steady fuel flow.
- Modified the steam production and by-product fuel use in the boiler house to reduce variation in by-product fuel demand.

Housekeeping and Repetitive Maintenance

- Programs to assess and improve building heating.
- Steam system conservation programs (traps, leaks, insulation).
- Increased involvement of the operating people in the energy management of their processes.
- Maintenance of gas distribution systems to increase utilization of by-product fuels.

Ferrous Metals Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		271,138 terajoules
New base year (1985) equivalent energy inputs		268,297 terajoules
Net Improvement = –1.1%		
Adjustments — None		
Efficiency gain 1974 - 1985	9.1	
1986	–1.2	
1987	0.1	
Total gain 1974 - 1987	8.0%	

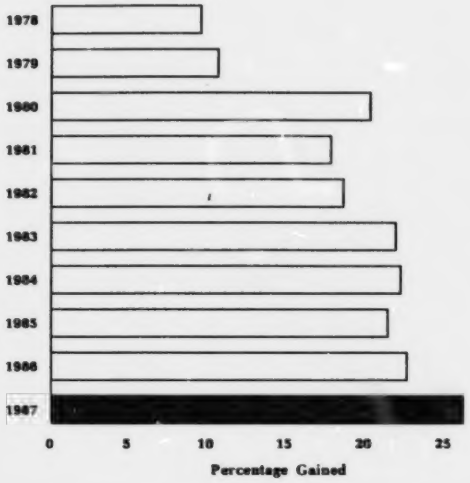
Ferrous Metals Industry
Energy Use

Type	Units	Terajoules	Percentage of Total Consumed 1987	1986
Natural Gas	1,427,500,000 m^3	53,103	19.6	19.7
Electricity	5,709,444 MWh	20,554	7.6	7.6
Liquid Petroleum Products Residual Oil	343,209,880 litres	13,900	5.1	4.6
Coal	6,330,380 tonnes	183,581	67.7	68.1
Total		271,138		

Food and Beverage Industry

Energy Conservation Task Force

Alexis L.W. Hyland
Chairman



This report covers an estimated 34% of the total food and beverage industry energy consumption. There is almost complete coverage of energy-intensive brewing, distilling, starch manufacturing, and sugar refining industries. The remaining sectors are composed of hundreds of small firms scattered throughout the country.

1987 Performance

The participating companies in this year's survey achieved an impressive gain of 3.15%, raising total efficiency to 25.92% relative to the 1977 base year. As a result, estimated pretax savings of $6.5 million were made available for other productive purposes.

Factors which affect energy performance in the food and beverage industry are shown in a table. In spite of very little growth in Gross Domestic Product (GDP), the amount of spending on new machinery and equipment has doubled since 1978. However, capacity utilization continues to fall — particularly in the beverage industry which has already seen extensive rationalization of older plants. These trends clearly reflect an awareness of the need for productivity improvements.

With little hope of expanding in the domestic market, which would increase profits and general productivity, the proposed Free Trade Agreement (FTA) is being viewed with mixed feelings. In a recent industry survey, when asked what impact the FTA might have on their company, 10.7% of management thought it would provide "strong growth", 32% said it would result in "moderate growth", but 35% felt there would be "little change", and 10% foresee a moderate decline in business. Regardless of the final outcome, companies in this industry will continue to experience very strong domestic and international competition and will have to modernize at a faster pace.

Task Force Activities

Task force activities featured development of a special computer software program that analyzes daily energy use patterns. The program was designed to reveal off-shift (base load) consumption and pinpoint locations for energy conservation. Input data is taken from meters and production records. It will be made available to interested companies in the industry.

Other activities involved presentation of an energy management seminar in Montreal and distribution of quarterly newsletters.

Group Performance

Bakeries

Energy utilization in this sector, comprising Canada's largest inte-

grated bakeries, improved 5.3% in 1987 boosting the total gain since 1979 to 17.9%. The average energy intensity of the participating companies is now 2691 kJ/kg. This intensity is about 16% higher than U.S. bakeries where economies of scale provide distinct advantages. One Canadian company is now planning a state-of-the-art "super" bakery in the Toronto region, which will introduce new efficiencies by concentrating bread production in the new plant while retaining specialty products in its smaller plants.

Baking technology has slowly improved in recent years which has allowed faster baking times and less energy use in the preparation and finishing stages. For example, residence time in ovens is down to about 18 minutes. Electricity use has slowly grown to the current level of 22%, while the natural gas and fuel oil shares have dropped to 72.2%. Recorded production quantities have remained virtually the same over the past five years.

Biscuit Manufacturers

Performance varies considerably throughout this sector because of a wide mix of products and company size. Energy intensity varies between 5000 to 7000 kilojoules per kilogram of product and accounts for 5 to 15% of total manufacturing expenses. Through continued careful monitoring of processes, milder weather, and operation at top capacities, energy utilization was improved 3.8% during 1987. This raises the total improvement since 1979 to 15.4%.

The proportions of total energy consumption (electricity 22.5%, natural gas 68.3%), have not changed significantly in the past five years in this mature industry.

Breweries

This sector consists of three large multiplant companies and five intermediate-sized breweries. There is a growing number of microbreweries in Canada but these are not yet included in the survey.

Energy efficiency improved 1.4% in 1987, raising the total gain to 7.5% since 1975. The industry uses an average 299 megajoules per hectolitre of production, down from 306 MJ/HL in 1986. The improvement is partly due to a 3% increase in production, but more importantly from constant attention to housekeeping activities. Energy efficiency is highly sensitive to capacity utilization levels, which were uneven across the industry because of the shifting popularity of different brands.

Brewers are very energy conscious even though energy costs represent only 3% of their total manufacturing expenses. The three largest companies use sophisticated computer accounting systems to monitor monthly performance. The smaller companies tend to rely on traditional cost accounting methods.

In addition to housekeeping and minor retrofit projects, one of the major companies is now installing a submetering demonstration project in co-operation with the Ontario Ministry of Energy and Ontario Hydro. Other companies are updating their technical audits to identify possible savings. One of the smaller companies reported setting up an energy management committee. One quarter of the companies reported installing energy conservation retrofits in 1987, and the same number plan to do so in 1988.

Distilleries

The distilling industry is going through a major down-sizing as a result of a 25% reduction in sales in the past five years.

This rationalization and concentrated efforts to improve energy utilization in the existing plants has resulted in a respectable efficiency gain of 2.5% in 1987. Overall, efficiency has been improved 26% since 1976. Average energy intensity has thus been lowered to 40,594 kilojoules per (absolute) litre.

Three-quarters of the companies reported completion of energy conservation projects during 1987 and report plans for additional projects in 1988. Many of these projects are the outcome of recent plant audits. For instance, retrofits to distillation columns and reboilers, installation of vapour recompression machinery, recovery of boiler blow-down energy, new burner controls, and better plant heating systems, were the means for improving intensities.

The proportion of natural gas consumption is now down to 80.4% compared with 90% in 1984. Meanwhile, the electricity share has grown to 18% from 8%. Token quantities of fuel oil are used only for backup purposes. Because purchased natural gas quantities are very large throughout this industry, the largest companies are able to use "buy/sell" contract arrangements with Western producers, while the smaller companies receive sizeable discounts from their local utility.

Confectionery Manufacturers

After making some very impressive efficiency improvements between 1980 and 1985, energy utilization increased only 0.9% in 1987. This sector is also experiencing major rationalizations with some plant closings and consolidation of product lines in expanded facilities. The results of these changes have not yet been realized.

Companies are continuing their energy conservation activities, however, and cite waste heat recovery, equipment and piping system insulation projects, and replacement of steam vacuum jets with mechanical pumps as sources of cost savings.

The participants spent approximately $9.3 million on electricity

and fuel, which was 10 to 15% of their total manufacturing expenses. Electricity supplied 31.6% of total consumption and natural gas virtually all of the remainder.

The energy intensity of products varies considerably throughout the reporting companies. Manufacturers of ice cream require approximately 15 MJ/kg, chocolate producers use about 13 MJ/kg, and other confectioneries demand about half of the latter amount because of less processing and refrigeration.

Food Processors

Energy management in this group of companies is especially difficult because of the seasonal swings in production and large turnover of product lines which require very flexible processing equipment. Food processing requires heating and cooling large quantities of water for precooking, sterilization, and handling of the various raw materials. Thus, energy conservation focuses on these operations.

The participants in the survey improved their energy utilization by 4.9% in 1987. The total gain is 23.1% since 1976. Much of this improvement has been achieved from changes to the steam plants, i.e., automation of boiler operation, maintenance of steam traps, installation of economizers, pre-heating boiler feed-water with solar energy, increased recovery of condensate, etc. One company is now installing cogeneration equipment to take advantage of the balanced steam and electrical load situation to lower its purchased costs of energy.

All of the participants reported that energy costs and performance are monitored on a monthly basis, and nearly one-quarter of the larger companies are able to track efficiency of submetered processes on a daily schedule.

Fisheries

Efficiencies in the greatly rationalized fisheries industry improved 2.6% during 1987, which raises the total gain to 26.5% since 1977.

It is estimated that the participants spent $5.9 million on electricity, and another $6.3 million on fuel for factory use. Energy costs usually amount to about 10% of total processing costs. Heavy fuel oil is the predominant source of fuel because of the size and location of the plants. In previous years, sizeable quantities of waste fish oil were used for energy, but companies are now reprocessing it for industrial use as fish meal and oil.

The improvements in the fish industry have been helped by increased production of high value-added products, which has increased profit margins and investment in new equipment. For example, innovative computer monitoring of fillet cutting has vastly reduced waste and increased output. New fish freezing methods, such as the "blast" technique of circulating chilled and properly humidified air around large batches in controlled room environments, or in continuously fed tunnel arrangements, are replacing the older "slow" brine immersion systems.

Grocery Products

The diversity of products made by the companies in this sector make it difficult to generalize on the aggregated results. What is common, however, is the strong efforts being given to energy conservation. Energy efficiency in this group improved 6% during 1987 to raise the total amount of energy conserved since 1977 to 32%.

Typical energy conservation activities cited in the 1987 survey were: boiler flue gas heat recovery projects, boiler automation, lighting improvements, and installation of unit heaters to allow shutdown of large boilers in the off-season. Some changes in processes, and on-site generation of nitrogen, were also actions which helped performance during 1987.

Three-quarters of the total energy used is supplied by natural gas, with electricity supplying 20%, and fuel oil and propane the remainder. All of the participating companies in this sector are large enough to benefit handsomely from discounted natural gas prices and/or "buy/sell" direct purchase arrangements.

The annualized rate of improvement of 3.2% means the participating companies saved about $644,000 in energy costs in 1987 alone.

Meat Packers

After experiencing a decrease in energy performance in 1986 the participants reported a gain of 5.3% in 1987. This raises the total performance to 41.9% since 1977. The actions cited for these accomplishments were additional waste heat recovery in the powerhouses and singeing operations, attention to combustion efficiencies, weekend shutdown of unused equipment and upgrading plant lighting systems. Tighter control of production scheduling and operating procedures, plus higher maintenance standards were also mentioned as major reasons for productivity gains.

Extensive modernization of plants is now underway in the larger companies. These changes are being made primarily to increase product variety and quality, with positive impact on energy utilization.

Thirty-one percent of the total energy is supplied by electricity, while 67% comes from natural gas.

Poultry and Egg Processors

This sector includes a mix of poultry and egg processors with slightly dif-

ferent energy requirements. For example, energy intensity for the egg and egg-product processors averages about 4500 kJ/kg while the poultry processors' average is 2540 kJ/kg of product.

Energy utilization improved 3.1% in 1987, raising the total to 11.8% over 1982 operating conditions. These gains have been achieved mainly by improved plant HVAC systems and by recovery of waste heat from the scalding water.

The companies in this sector get about 48% of their energy from electricity. Propane usually supplies 1.7%, and diesel and gasoline contribute 7.5% of the total consumption. Heating requirements are supplied by the locally available fossil fuels, i.e., natural gas in urban centres, distillate fuel oil in rural areas. The unit costs for heating appear to be about $6.24/tonne for those using natural gas, and $5.12/tonne for the fuel oil users. The difference may stem from the fact that plants reporting fuel oil consumption tended to be larger and located in Quebec where oil is more economical.

Companies in this sector have not benefited from natural gas deregulation because of low annual consumption, but the potential for grouping together in a purchasing co-op may bring cost savings in the near future.

Soft Drink Producers

The carbonated beverage industry consists of many independent companies that make a number of popular brands under licence. Energy is mainly used for HVAC, sterilization, bottling operations, and raw material refrigeration. Bottlers require about 3500 to 4000 kilojoules per litre, while canners use 1000 to 1500 kJ per litre.

This sector experienced a 0.06% increase in energy intensity in 1987, probably due to the number of companies reporting for the first time. The total efficiency gain is 28.1% over aggregate 1980 operating conditions. Several companies which reported performance increases cited the milder weather in the past two years as a contributing factor, as well as tighter production schedules and minor building heating improvements.

Typical energy costs are $50,000 for the smaller plants and $400,000 for larger urban plants. This sector is also experiencing some concentration where fewer, but larger, more efficient plants are emerging.

Starch Manufacturers

The companies in this sector manufacture a mix of products, including wheat and corn starches, glucose, alcohol, gluten feeds, adhesives and resins. Efficiency gained 0.4% in 1987 to raise the total improvement to 32.4% over 1976 operating conditions.

Productivity gains were low in 1987 because most of the plants were running at top capacity and the improvements from previous energy conservation efforts have already been seen in the results. However, future gains should be forthcoming from biogas recovery projects and upgrading of instrumentation systems with computerized controls. This sector is already an advanced technology user, with one company cogenerating most of its own electricity.

Approximately $31.7 million was spent on fuel and electricity. Natural gas supplied 80.7% of the total energy, while purchased electricity accounted for nearly 17%. The companies have all taken advantage of the deregulated natural gas market situation, most favouring the "buy/sell" direct purchase option. Only one company opted for the "competitive market program" (CMP) discounts.

Proportions of energy shares have not changed since the beginning of performance monitoring and there appears to be little possibility of fuel substitution.

Sugar Manufacturers

Performance gained 0.7% over 1986, raising the total gain since 1975 to 31.5%, in spite of a 7.5% drop in production.

The energy intensity of American sugar plants average 3541 MJ/tonne. Canadian sugar refining industry's energy intensity is 3686 MJ/tonne.

Canadian plants, however, appear to use twice the amount of electricity in their operations (4.0%) compared with the American average of 2.3% because lower electrical prices favour purchase from the local utilities rather than in-house generation.

Food and Beverage Industry

Energy Efficiency Improvement

Current year (1987) total energy inputs		37,615,448 gigajoules
New base year (1985) equivalent energy inputs		39,342,000 gigajoules
Net Improvement = 4.4%		
Adjustments — None		
Efficiency gain 1977 - 1985	21.5	
1986	1.2	
1987	3.2	
Total gain 1977 - 1987	25.9%	

Energy conservation is a major concern in this industry as indicated by the number of companies planning new audits of their facilities. Some companies have already taken advantage of the provincially sponsored programs and are reviewing the results for further improvements.

Energy Use Patterns

The relative shares of energy have not changed more than 2% in the last seven years, with a slow trend toward greater use of electricity and less heavy fuel oil. These shifts reflect conservation of combustion fuel and greater use of automated equipment. Electricity now supplies 20.8% of the total, while the natural gas share is 68.3%, fuel oil 9.1%, and miscellaneous fuels the remaining 1.8%.

Future Outlook

Faced with mature processes and slow to moderate volume growth, future efficiency gains will depend primarily on close attention to the fundamentals of energy management. This involves frequent monitoring and analysis, adherence to good operating and maintenance standards, and replacement of inefficient equipment. Continued rationalization of obsolete plants will help, but this will be slow given the need to amortize existing plants and equipment.

It is now expected that accelerating energy prices will raise the importance of energy conservation and direct more investment into improvement projects. Waste heat recovery will probably continue to be the most important source of engineered savings.

Food and Beverage Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1987	1981
Natural Gas	690,997,810 m^3	25,705,118	68.3	64.8
Electricity	2,168,663 MWh	7,807,187	20.8	14.6
Liquid Petroleum Products				
Distillate Oil / Residual Oil	85,390,541 litres	3,441,599	9.1	19.6
Diesel and Gasoline	8,577,062 litres	328,812	0.8	0.6
Other Fuels				
Propane	7,976,583 litres	212,177	0.6	0.4
Steam	n/a	109,900	0.3	—
Others	n/a	10,655	0.1	—
Total		37,615,448		

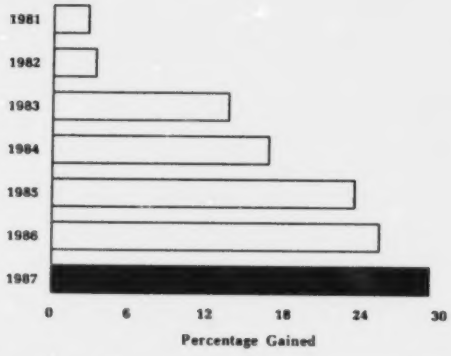
Energy Performance

Industry	Original Base Year	Number in Survey	Improvement 1987 %	Improvement Total %	Energy Costs $'000	Annualized Savings $'000
Bakeries	1979	6	5.33	17.93	7,616	175
Biscuit Manufacturers	1979	6	3.82	15.44	6,562	129
Breweries	1975	8	1.41	7.53	43,926	292
Confectionery Manufacturers	1978	9	0.93	25.16	9,344	363
Distilleries	1976	12	2.51	26.01	25,099	765
Fisheries	1977	4	2.61	26.51	12,195	362
Food Processors	1976	14	4.87	23.06	35,619	763
Grocery Products	1977	12	6.04	32.03	18,242	644
Meat Packers	1977	10	5.27	41.94	24,571	1,135
Poultry and Egg Processors	1982	13	3.09	11.79	7,141	172
Soft Drink Producers	1980	29	–0.06	28.14	6,360	266
Starch Manufacturers	1976	4	0.39	32.40	31,742	963
Sugar Refineries	1975	5	0.75	31.46	20,705	543
	1977	132	3.15	25.92	$249,122	$6,572

General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



The following report is based on a survey of the energy management activities of a group of member companies of The Canadian Manufacturers' Association (CMA). These companies are not part of any of the other sector conservation task forces. The mix of manufacturing and processing operations among the general manufacturing participants is quite diverse.

However, the respondents (in 1987, 57 companies representing 190 manufacturing plants) generally provide a good indication of energy productivity changes and conditions found throughout the whole manufacturing industry in Canada.

General Performance and Business Conditions

Energy utilization in the participating firms improved 3.8% during 1987. Thus, the general manufacturing task force total efficiency improvement is now 29.1% since the 1981 base year.

It is estimated that participants spent $60.5 million on electricity this year, $28.1 million on natural gas, and $4.6 million on petroleum products. However, cost savings of $3.7 million have been realized, based on the annualized rate of performance improvement of 3.8%. Furthermore, the accumulated savings for all participants (at current energy prices) now amount to about $41 million.

In 1987, participating companies focused most of their attention on improving profit margins and meeting production commitments, rather than on productivity improvement. Therefore, gains that were realized could have arisen primarily from good business conditions as shown in the graph. According to Statistics Canada figures, the Gross Domestic Product (GDP) index rose 4.7%, capacity utilization was stable at 80%, and the capital investment index increased by 8.7%. All these factors are generally very favourable to energy utilization improvement.

In spite of these satisfactory gains, more will have to be done in the near future to meet the growing pressure to be competitive and technologically current.

In a recent CMA "Issues Survey", there was widespread agreement that the rate of future capital investment and R&D must rise. Of managers surveyed, 5.7% felt they had "leading-edge technologies and facilities", 22% thought they were "all up-to-date", 60.8% were "somewhat up-to-date", and only 8.3% were operating with "generally obsolete systems". According to these executives, free trade competition will result in even greater domestic investment (33.4%), as opposed to no change in current intentions (29.7%).

What's more, companies indicated that investment in new manufactur-

ing technology over the next three years will be "very significant" (30.6%) and "moderate" (45.5%), compared with only 19% of executives who saw "very little" need for improvement. All this suggests that more effort is going towards modernization which should bring with it the increased energy savings which are so much a part of most new manufacturing technologies.

Long-term analyses of the effect of escalating energy prices on end-use energy demand have found that a 10% increase in energy prices brings about a 3.4% reduction in energy demand. That was the finding of an International Energy Agency study which included North American industry. The analysis attempted to exclude the side effects of income growth and major structural changes that were not primarily or directly dependent on end-use energy prices.

The analysis also discovered that in periods of falling energy prices, demand generally increased less than 3.4% for a 10% decrease in energy price.

Supporting evidence for this study is found in the general manufacturing industry, where average energy prices have increased by 89% since 1981, and which has posted a 29.1% improvement in energy utilization. Thus, for each 10% increase in energy price, the energy utilization (demand) has been reduced virtually the same, 3.3%.

Group Trends

Rubber Products

The five reporting companies in this group showed an aggregate 3.2% saving for 1987. Their energy costs usually vary between $1.2 and $5 million per year.

The large amount of electricity used in this sector — 31% of their total consumption — has prompted many of the participants to focus more attention on demand management control.

Electricity consumption is becoming a very important issue, especially in Ontario where "time-of-use" (TOU) rates will be introduced in the near future. In other provinces demand charges are rising and penalties are high because there are no ratchet clauses, that is, the peak demand reached during any one month sets the demand charge for the full year.

Fossil fuels accounted for 67% of the participating companies' total energy consumption. Those companies with access to natural gas have taken full advantage of the various discount programs offered by local gas utilities, with cost savings in the order of 5 to 10%.

However, because of low profit margins and small capital improvement budgets, plus the general uncertainty surrounding this sector, energy conservation improvements are kept at the low-cost level throughout most of the sector.

Chemical, Pharmaceutical and Medical Products

The seven companies in this group report a weighted average improvement of 2%. Energy costs for the 28 different plants vary widely from $35,000 to $2.5 million. Productivity has improved 20% since its aggregated 1981 base year.

Companies report facility-related energy conservation projects, including recovery of waste heat and electrical demand control. In spite of the low potential for process improvements, all reports were submitted by staff with titles such as: energy co-ordinator, plant services engineer, utilities engineer, energy program co-ordinator, etc., which suggests that energy management is a very worthwhile activity in these firms.

While there appeared to be high energy monitoring standards throughout this group, demonstrated by the use of specialized performance monitoring programs, there was a wide divergence in the application of some common energy conservation equipment, such as electrical demand controls and stack gas recuperators. Reports also indicate that Quebec operations are progressing towards more electrification of plants and heating systems, while Ontario companies are benefiting more from deregulated natural gas contracts.

Foundries, Forging, and Heavy Metal Operations

Sixteen companies in this high energy-intensity category had efficiency gains that averaged 5.2% for the year. This group has improved energy utilization 12.6% over 1981 consumption rates, despite assorted setbacks experienced during the recession.

The energy conservation actions in this group are quite progressive because of high-energy to manufacturing-cost ratios of 10 to 15%, and because of competitive pressures brought on by new foreign entrants into the industry. Notable energy savings have been realized through unusual projects such as oxygen enrichment combustion systems, conversion of pneumatic power systems from steam to compressed air, and changeover to continuous rather than batch operation. More conventional projects include conversion to induction heating on furnaces — especially in Quebec where very attractive off-peak power rates exist for high-load factor customers. Heat recovery and housekeeping actions continue to be the mainstay of energy conservation in this sector.

Energy intensities in ferrqus casting operations range between 4600 to 5700 megajoules/tonne depending on the size and finishing requirements of the products. Non-ferrous castings require about 3300 to 3500 megajoules/tonne due to lower melting temperatures and simpler casting methods. Forging operations often require 25,000 to 30,000

megajoules/tonne when several billet reheating steps are required and product heat treatment is involved.

The major gas consumers in this group are also enjoying large savings from deregulated natural gas contracts. Opportunities still exist for substitution of fossil fuels with electricity.

According to the survey, additional process heat recovery is possible, but the capital outlay would be high because of clean-up requirements.

Light Manufacturing

Twenty-nine companies reported an aggregate productivity improvement of 3.3% on their total energy consumption, estimated to cost $27.2 million.

The companies in this group make a huge variety of items primarily for the consumer and construction markets. They are as much alike as alfalfa processing is to the manufacture of snowmobiles. Energy use therefore varies considerably in each operation but generally shows a pattern of about 25% electricity, 70% natural gas for buildings and miscellaneous heating and drying, and around 5% for plant vehicles. Energy costs fall between 5 and 10% of total production expenses. Because of the large amount of energy used for heating, several companies mentioned lower consumption because of the warmer weather during 1987.

Manufacturers in this sector are generally concerned about the energy losses from the building envelopes and recovery of waste heat from exhaust systems and equipment such as air compressors. Results of recent energy audits done in this sector show that added building and equipment insulation is still justified in two-thirds of the instances. The frequency of economically viable heat recovery projects applies to about one-third of the sites, and it has been found that about one-quarter of plants should still make power factor and load control improvements.

Typical plant energy-intensities in this group are: metal stamping operations, 640 kW/m^2 of floor space; office equipment and furniture manufacturing, 795 kW/m^2; scientific and photographic equipment plants, 830 kW/m^2; aluminum extruders, 1080 kW/m^2; and machine shop type operations, 1150 kW/m^2.

General Manufacturing Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1987	1986	1985
Natural Gas	234,822,181 m^3	8,735,851	51.7	53.6	60.2
Electricity	1,765,668 MWh	6,356,405	37.6	35.3	28.1
Liquid Petroleum Products					
Distillate Oil	921,065 litres	35,921	0.2	0.7	1.2
Residual Oil	36,516,788 litres	1,478,930	8.8	8.5	9.6
Diesel	2,637,276 litres	105,227	0.6	0.7	0.4
Gasoline	2,444,076 litres	88,475	0.5	0.5	0.1
Other Fuels					
Propane	1,979,660 litres	52,659	0.3	0.3	0.3
Steam	n/a	36,447	0.2	0.2	—
Others	n/a	22,471	0.1	0.2	0.1
Total		16,912,386			

General Manufacturing Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs — 16,912,386 gigajoules

New base year (1985) equivalent energy inputs — 17,943,940 gigajoules

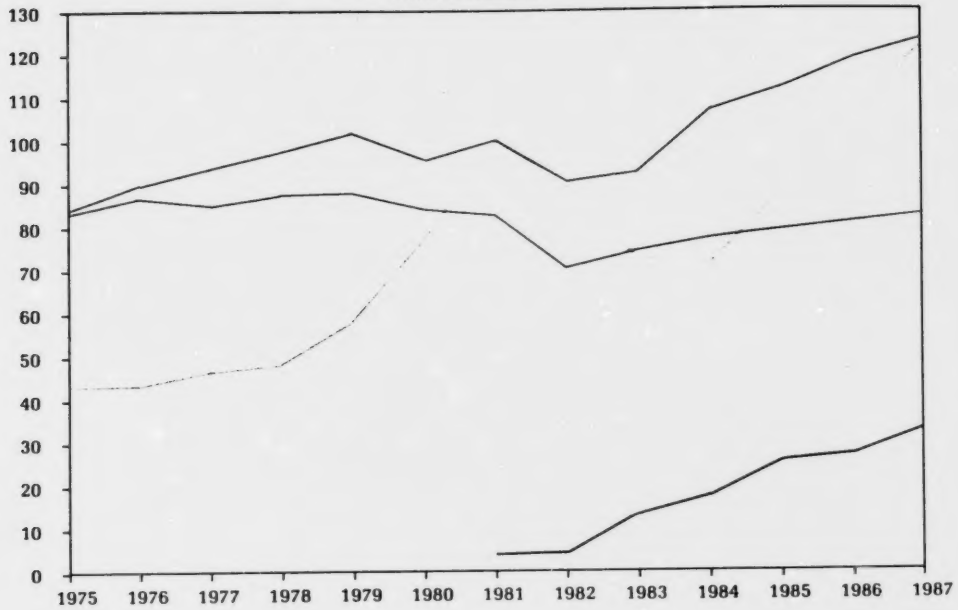
Net Improvement = 5.7%

Adjustments — None

Efficiency gain 1981 - 1985	23.4
1986	1.9
1987	3.8
Total gain 1981 - 1987	29.1%

General Manufacturing

Performance



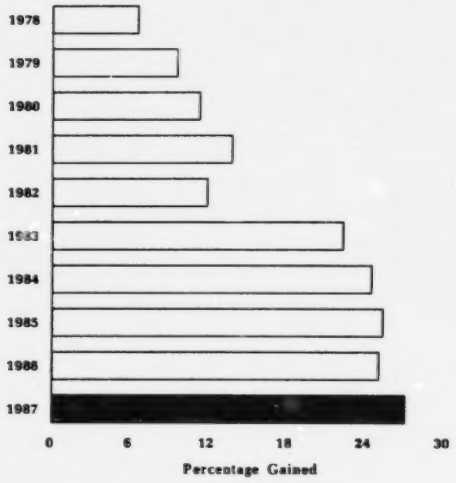
Legend: GDP Index ('81 = 100)
Capital Investment Index ('81 = 100)
Capacity Utilization (%)
Efficiency Gain (%)

Source: Statistics Canada and Task Force Reports.

Industrial Minerals Industry

Energy Conservation Task Force

John A. Clarke
Chairman



Task Force Description

The Industrial Minerals Energy Conservation Task Force represents nine industry sectors that mine, process and/or manufacture a variety of non-metallic materials and products. The combined Gross Domestic Product (GDP) of these industries amounted to $9 billion in 1987.

This report covers about 80% of the total industrial minerals energy consumption. The highly energy-intensive abrasives, cement, and glass manufacturing industries are fully represented. Ninety per cent of the asbestos operations are included in the survey result. In the more diversified but less energy-intensive clay and concrete products, lime manufacturing, refractories, and miscellaneous minerals sectors, the survey includes only the largest producers.

General Performance

The group's consolidated energy efficiency gain was 2% in 1987 — raising the total since 1975 to 27.1%. Individual sector results follow.

Based on an estimated cost of $432 million for fuel and electricity, 1987's increased efficiencies added some $9.9 million to the level of previous cost savings achieved by the participating companies. The 1987 savings are generally attributed to a variety of factors, including higher plant outputs and capacity utilizations, a high degree of attention to housekeeping and maintenance, and a small number of energy conservation projects.

Increased production and capacity utilization were the dominant beneficiary factors to the sector's energy efficiencies this year. The 1987 industrial mineral's GDP index rose a tremendous 9.7 percentage points and capacity utilization went up 6.6 percentage points as a result of increased sales in the construction industries. The downturn in the rate of capital investment did not affect 1987 performance but will, in some small measure, impact on future results.

Plant housekeeping and maintenance assumed less importance in industrial minerals operations since production rates were being pushed to high levels. Not only is there less opportunity for proper maintenance, but wear and corrosion also occur more rapidly as process temperatures approach maximum limits. Thus, in spite of the efficiency gains made by additional production, there was undoubtedly significant energy losses caused by higher rates of deterioration in plant equipment, particularly in process kilns and melting furnaces where the integrity of insulation systems is important.

Very little efficiency gain has come from new or revised processes in this industry. Most of the tech-

nologies employed are very mature and not easy to change because of the large invested capital. However, some exciting possibilities for future process energy savings exist. For example, a new glass melting technique takes place in the burners themselves, but this technology is still in the R&D phase.

Sector Reports

Abrasives

This report covers four companies that make raw aluminum oxide and/or silicon carbide by electro-fusion technologies.

Group efficiency gained 2.3% during 1987 by optimizing raw material blends, further installation of new process controls and some reported process modifications. Close control of electric demand and power remains the main focus of energy conservation in this sector.

Silicon carbide is made by fusing coke and sand together in large donut shaped electric resistance "furnaces". Sacrificial sawdust is placed in the batches to burn in a manner that creates passage for the escaping carbon monoxide gases which then must be burned with natural gas to meet environmental emission standards. The energy intensity of this process varies between 12,000 and 14,000 megajoules per tonne of product, depending on the size and configuration of the furnace. About 88% of the total energy is supplied by electricity and 12% from natural gas for exhaust cleanup. Heat is also captured from the raw material coke but this does not enter into the efficiency calculations.

Raw aluminum oxide is made by fusing chemically purified alumina ($A1^2 0^3$) with fluxing agents and other admixtures in conventional arc furnaces. The electrical intensity of this process is in the 10,000 megajoule per tonne range.

Energy efficiency has always been a high priority of companies in this sector, as shown by their positioning near the cheap electricity generated at Niagara Falls. But as electricity costs have risen, better operating controls have been installed and refinements to operating procedures have been necessary to keep manufacturing costs to a minimum. Electrical power factors are kept near unity to minimize cost/kWh rates. Power demand is controlled by sophisticated instruments and by careful production scheduling. Operators' skills have also been honed to charge the furnaces in a manner that minimizes the required amount of fusion energy.

It is estimated the group now spends about $26 million for electricity and fuel but saved an additional $632,000 during the year from improved conventional energy conservation techniques.

Plasma Extended Arc Reactor (PEAR) technology might be used in this industry in future to replace conventional carbon arc furnaces but development is still in the pilot-plant stage and the economics of a changeover are not yet proven.

Asbestos

The effects of rationalization, plus general productivity efforts, and a minute upturn in volume, led to a 3.5% improvement in energy utilization during 1987. There is considerable variation in energy intensities from the average 6828 megajoules per tonne of processed raw fibre because of the different sizes and locations of each plant. One company is located in British Columbia and the others in Quebec.

It is estimated the industry spent about $41 million for fuel and electricity during the year, but efficiency gains saved $627,000.

The British Columbia company uses fuel oil to supply all its energy needs, including generation of electricity for its mill and the town site. In the Quebec companies, 35% of the total energy is supplied by electricity (costing about 3 cents/kWh), 42% from residual fuel oil (at 10 to 13 cents/litre), and the remainder of the total is diesel and gasoline used for site vehicles and miscellaneous plant and maintenance operations. The relative shares of energy have remained the same since monitoring began. Energy costs still amount to about 20% of the total manufacturing costs in this sector.

Cement Manufacturing

The eight Portland cement manufacturers produced 10.4 million equivalent tonnes[1] in 1987 to supply all of Canada's domestic needs plus some clinker and finished cement for export to subsidiary plants in the United States.

Overall efficiency of the group improved 2.8% in 1987 after having experienced a loss of 2% last year.

The average total energy intensity was 4844 megajoules/equivalent tonne, of which fossil fuels supplied 87.4% of the total and electricity 12.6%. Approximately 83% of the total production was made in dry-process plants which operate in the 4583 megajoule/tonne range. Wet-process plants usually require about 6094 megajoules/tonne for operation.

Total cost of fuel and electricity amounted to $191 million which usually represents about 23% of the total manufacturing costs. The surveyed companies saved approximately $4.4 million during 1987 on their energy expense, indicating that energy management is indeed an important consideration in cement manufacturing.

[1] An equivalent tonne is a weighted measure of production that accounts for the different energy intensities required to make clinker and cement. Approximately 92% of the total energy required is used to produce clinker. The remaining 8% is used to grind the clinker to produce finished cement. In some plants clinker is exported without being ground.

No particular technical or retrofit projects were cited for the efficiency gains reported. Capacity increases helped in eastern and western plants, but the central plants were already operating at their peaks. Careful scheduling of maintenance shutdowns and maximum production in summer months has helped.

Some major fuel switches have occurred since 1975 in an effort to reduce operating costs. The coal share has increased from 10.8% to 64%, while natural gas use has dropped from 49.5% to 31.6%. The consumption of natural gas was increased during 1987 by 7% as a result of the deregulated natural gas contracts which priced some gas competitively with coal. The full benefit of this change has probably been achieved now that gas prices are starting to firm up and cheaper alternatives, e.g., the possible use of municipal waste, await environmental approval.

Clay Brick, Tile, and Clay Products

Energy utilization improved 2.1% during the year raising the total gain in this sector 29.3% over the 1978 base year level. Based on an estimated fuel and electricity cost of $16 million among the surveyed companies — which represents about 35% of the total industry usage — increased efficiency saved the participants $559,000 for use elsewhere.

The energy intensity of fired clay brick now averages 3533 megajoules/tonne (1.8 tonnes/1000 equivalent units) among the participants. However, the energy intensity of clay tile products is often three times this amount because of the great variety of different shapes that cannot be mass produced.

Performance was up again this year primarily from additional increases in volume and capacity utilization throughout the industry. One major Ontario company is now building a new state-of-the-art plant to double its capacity. Other companies report that scheduling more production in summer months helped efficiencies. Several mentioned added benefits from recovery of exhaust heat. Some companies in this industry are also using oxygen-enriched combustion systems to improve furnace efficiencies.

Energy management is an extremely important activity because fuel and electricity costs generally range between 20 to 25% of total manufacturing expenses. Natural gas provides 92.7% of the purchased energy while electricity accounts for 6.8%. Energy now costs about $27/1000 brick equivalents in most companies while those with discounted natural gas contracts are generally in the $22/1000 units range.

Concrete Products

The concrete product manufacturers also benefited from increased production and higher capacity utilizations which helped raise the 1987 performance 1.9%. Energy utilization is now 16.2% better than it was in the 1979 base year.

Product energy intensities are variable throughout the surveyed companies because of the different kiln configurations, i.e., autoclaves versus low pressure kilns, different product specifications, and plant sizes. However, the average for concrete block "equivalents" appears to be in the 10,400 kilojoule/unit range.

Electricity normally supplies 10% of the total consumption, diesel fuel and gasoline provide 17% for materials handling and the balance (72%) comes from natural gas for steam boiler fuel.

All of the surveyed companies have benefited from discounted natural gas contracts. Two of the largest companies (not in the survey) buy natural gas on direct "buy/sell" arrangements with even greater cost savings.

Modest energy conservation savings in this low energy intensive industry might come from improvements to the kiln steam heating systems and kilns, but there doesn't appear to be much potential left in the housekeeping and production scheduling category.

Glass

The five companies surveyed in this sector operate 19 large continuous glassmaking plants which produce about 90% of the glass containers, flat glass and fibre insulation used in Canada.

Efficiency in the surveyed companies dipped slightly by 0.2% as a result of operating plants in a range beyond their optimum efficiency levels. Most plants report full shift schedules with a large backlog of orders. Overall performance is 33.8% better than 1974 operations.

It is estimated fuel and electricity cost $100.5 million during the year based on an average $5.36/gigajoule cost factor. Notwithstanding the decreased performance in 1987, the annualized cost savings is in the order of $2.7 million per year due to past energy conservation and general efficiency improvements. Energy intensities are monitored very closely in the surveyed companies but cannot be revealed because of the intense market competition and single coverage of some product lines.

Most of the industry's energy savings have been achieved by modifications to the glass melting furnaces and accurate control of heat in the different zones of the annealing ovens. In some plants, booster electric heaters have been added to the furnaces to provide direct heat and help agitate the bath for quicker melting. However, it takes about 18 to 24 hours for feed stock (blended silica, limestone, and sodium carbonate) and cullet to pass through the melting process.

Furnace insulation systems have gradually been improved to reduce heat transfer losses and extend their life up to several years in many cases. There are still major savings possible from better positioning of the burners to increase the radiant and convection heat input into the bath. Some U.S. tests have tried submerged combustion and radically new furnace configurations but these are still in the R&D phase. Additional exhaust heat recovery for preheating cullet and combustion air offer good possibilities for significant efficiency gains. Low excess air burners and combustion control systems have yet to be installed in all the plants.

Lime

Lime manufacturing is accomplished by calcifying quarried and crushed limestone in rotary kilns in a manner similar to the cementmaking process. About 6300 megajoules/tonne is required for production of lime. Energy costs constitute up to 40% of the total manufacturing cost, which is about twice that of basic raw materials.

Energy efficiency improved 1.5% in 1987 and is now 17.3% better than aggregate conditions in 1979. In this sector, efficiency went up somewhat with increased production and capacity utilization resulting from very good sales to the steel industry — the lime industry's major market. Performance was also improved by one company's new computerized kiln burner control system and another's total overhaul of its plant electrical system.

Natural gas is the most suitable fuel since it produces high purity lime products as required by the steel industry. Natural gas provides 56% of the total energy consumption. Coal and coke supply 42% and electricity constitutes only 2% of the total energy.

Miscellaneous Minerals

This sector produces a variety of materials such as silica sand for the glass industry, roofing granules, nepheline, sodium sulphate, and talc and raw crushed limestone for the chemical industry. Many of these processes require extensive crushing or pulverizing, milling, refinement, drying and grading before shipment.

Energy budgets are generally large and range between 5 and 15% of production costs. In these operations the energy balance is usually 20% from electricity, 73% for heating and drying (mostly from natural gas), and the remainder for diesel and gasoline for plant vehicles.

Energy management has become a more important issue because of rising processing costs. Changes are being made in production procedures, economizers are being installed on heaters and dryers, and steps are being taken to control electrical demand for greater efficiency. The group's improvement was 3% in 1987, which helped save the participants $380,000 on their aggregate fuel and electrical bill of $27 million.

Refractories

A clear indication of performance trends was unavailable in this small group this year because of significant changes in the reporting population, a change to more energy intensive products in one company, and a general move in others toward less energy intensive products. Partly because of these trends, some of the companies were reluctant to participate in the survey.

It is known, however, that companies are making concerted efforts to identify and improve their operations by having new technical audits done, following up with investment in new equipment. Previous reports show average fired product energy intensities in the 6500 megajoule/tonne range and energy costs up to 12% of the manufacturing expenses. These factors usually mean that energy management is a closely monitored activity.

Future Outlook

The 1990 efficiency target of 35% (compared with 1975 energy intensities) will probably be achieved because of the increasing importance of energy management throughout the non-metallic minerals industry. The priority is increasing once more now that utility cost rate structures are changing and noticeably affecting the costs of some companies in this industry. For example, Ontario Hydro is planning to introduce "time-of-use" rate structures in 1989 that will penalize high load factor users who may have little opportunity to shift production to off-peak periods. What's more, minimum natural gas prices have probably been reached and are expected to rise again.

In view of these rising utility costs and the increased competition in the market place, companies will be shifting the emphasis back to productivity programs as a means of profit improvement.

Industrial Minerals Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		91.262 petajoules
New base year (1985) equivalent energy inputs		92.855 petajoules
Net Improvement = 1.7%		
Efficiency gain 1975 - 1985	25.4	
1986	–0.3	
1987	2.0	
Total gain 1975 - 1987	27.1%	

Industrial Minerals Industry
Energy Use

Type	Units	Petajoules	Percentage of Total Consumed 1987	1986	1985
Natural Gas	1,047,850 m^3	38.980	42.7	40.1	42.6
Electricity	3,921,892 MWh	14.119	15.5	15.7	15.6
Liquid Petroleum Products					
Distillate Oil	14,471 kilolitres	0.564	0.6	0.7	1.2
Residual Oil	89,253 kilolitres	3.615	3.9	4.2	5.1
Diesel and Gasoline	46,004 kilolitres	1.825	2.0	2.0	2.2
Coal	9,665,736 tonnes	31.028	34.0	36.6	32.4
Other Fuels					
Propane and LP Gas	8,587 kilolitres	0.228	0.2	0.3	0.2
Steam	n/a	0.903	1.0	0.4	0.5
Totals	1987	91.262			
	1986	82.632			
	1985	80.081			
	1984	79.213			
	1983	74.291			
	1982	84.229			
	1981	100.403			
	1980	98.615			

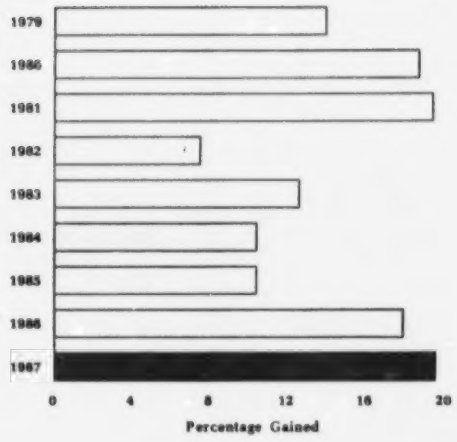
Industrial Minerals Industry
Energy Consumption

Sector	1987 Consumption Petajoules	1987 Efficiency Gain (%)	Total Efficiency Gain (%)	Base Year
Abrasives	2.363	2.33	11.3	1982
Asbestos	4.613	3.54	12.0	1979
Cement	50.480	2.81	27.1	1974
Clay Brick	3.674	2.08	29.3	1978
Concrete Products	0.694	1.92	16.2	1979
Glass	18.484	–0.21	33.8	1974
Lime	5.258	1.50	17.3	1979
Miscellaneous	4.721	2.99	13.7	1977
Refractories	0.975	–0.71	10.4	1975
Totals	91.262	1.99	27.1	1975

Machinery Industry

Energy Conservation Task Force

Frank A. Hlohovsky
Chairman



Task Force Description

The Machinery Industry Task Force represents approximately 130 firms engaged in the production of a wide range of industrial machinery and equipment used by Canada's resource, processing, manufacturing and service industries. The industry's typical products are mining equipment, pulp and paper machinery, pumps, cranes, gears, etc.

The activities of the task force are co-ordinated by the Energy Conservation Committee of the Machinery and Equipment Manufacturers' Association of Canada (MEMAC). The very large variation in energy consumption by member companies hampers a common approach to energy management.

The large energy users have programs that stress energy efficiency in their manufacturing processes as well as in the machinery and equipment that they market. Smaller firms wish to dialogue on energy conservation matters.

Thirty-one firms responded to the 1987 survey for a participation rate of 30%, slightly better than the rate in 1986. Energy management awareness appears to be the major contributing factor.

General Performance and Progress

Results from the 1987 survey show an improvement of 9.4% over the revised 1985 base year. The aggregate improvement since 1975 is 19.8%. Savings as a result of conservation from 1985 to 1987 were $449,023.

In Ontario and Quebec, firms are taking advantage of energy conservation programs offered by the provinces. A firm that utilized the energy audit services of the Quebec Energy Bureau identified potential savings of $100,000 or 26% of total energy costs. On implementation, the savings were even higher.

Improvements to energy efficiency are expected to continue as firms invest in capital equipment which has the latest technological innovations. The resource industries in particular are demanding machinery and equipment with improved energy design. Furthermore, government programs, both federal and provincial, are placing renewed emphasis on energy conservation throughout the entire industrial environment.

Task Force Activities

The task force continues to monitor and publicize energy conservation developments to members. In many instances, because some member firms have low energy consumption rates, it is difficult to implement and sustain dedicated energy conservation programs.

The challenge for the coming year will be to increase the number of firms that have clearly defined pro-

grams and support the task force in its various activities. A weakness has been identified in the research and development process for energy conservation. While there are many government programs stressing energy conservation, there is no central agency which identifies, coordinates or implements improved energy design in machinery and equipment. As with other research and development in Canada, there appears to be a lack of linkage in what is being done in government research laboratories or agencies and what industry is demanding. An attempt will be made to identify research and development establishments where member firms may receive assistance in the design of energy efficient machinery and equipment.

Machinery Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		566,274 gigajoules
New base year (1985) equivalent energy inputs		625,356 gigajoules
Net Improvement = 9.4%		
Adjustments — None		
Efficiency gain 1975 - 1985	10.4	
1986	7.5	
1987	1.9	
Total gain 1975 - 1987	19.8%	

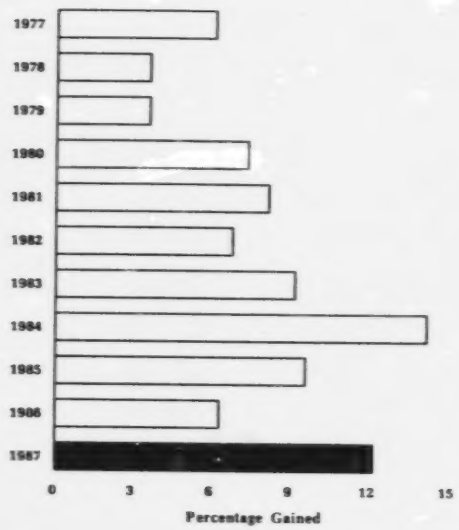
Machinery Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1987	1985
Natural Gas	8,294,040 m^3	308,538	54.5	53.1
Electricity	59,853,686 kWh	215,473	38.1	37.4
Liquid Petroleum Products				
Distillate Oil	753,465 litres	29,385	5.2	7.2
Crude Oil	40,000 litres	1,608	0.3	0.3
Gasoline	185,912 litres	6,730	1.2	1.0
Other Fuels				
Propane and LPG	3,125 kilograms 164,763 litres	4,540	0.8	1.0
Total		566,274		

Mining and Metallurgy Industry

Energy Conservation Task Force

Raynald Fournier
Chairman



Task Force Description

The Mining and Metallurgy Energy Conservation Task Force was organized in 1975 and is operated under the auspices of the Mining Association of Canada (MAC). Its membership includes major Canadian producers of metals including iron, copper, nickel, lead, zinc, gold, silver, aluminum and molybdenum. Producers of uranium, oil sand and fertilizer are also represented. The types of processes used include mining, milling, smelting, refining, indurating and fertilizer production.

A total of 13 companies participated in the 1987 survey, an increase of four over the previous year. One major new reporting company is the largest company now submitting data. The 13 companies reporting represent over 26 mine sites or 80 to 85% of the total mining industry.

Most companies reported using 1985 as the base year.

Activities of the task force are directed through an annually elected chairman and co-ordinated by an executive secretary contracted to carry out task force initiatives. For 1987, the chairman was Raynald Fournier of Quebec Cartier Mining Company, with Marilyn Culver providing executive secretary services in the MAC office.

Performance and Progress

Energy consumption per unit of production showed a negative trend from 1984 to 1986, caused by falling energy prices. This trend has been reversed with an improvement of 2.7% in 1987.

From 1973 to 1985 there was an improvement of 9.6%. From 1985 to 1987 the figure is 2.7% for a total of 12.3% at the end of 1987. The goal from 1985 to 1990 is an improvement of 15%.

Total energy used in 1987 by reporting members was 133,146 terajoules. This is equivalent to the energy content of 21.7 million barrels of crude oil. The energy saved was 8,194 terajoules, equivalent to 1.4 million barrels of oil. The total adjustments for industry performance were 304 terajoules. The weather in 1987 was warmer than in 1985 and this factor accounts for all adjustments.

Energy Use Patterns

In 1987 electricity represented 34.2% of energy usage.

Natural gas which has been replacing petroleum accounted for 18.4%. Petroleum accounted for 16.0% of energy used. Coal and coke have also replaced oil in some areas and together account for 8.4% of energy usage.

A category classified as "others" included hot water at 14.8%, steam

at 7.4%, naptha at 0.2% and propane at 0.6%. A major portion of energy consumption reported by the new participating company fell in this category. For this reason percentages changed drastically from the previous year.

The graph illustrates the historical distribution of energy between the years 1979 and 1987.

Task Force Activities

During 1987, the task force held two general technical meetings to exchange information on energy management. One of these meetings was hosted by a member company, Brunswick Mining & Smelting Co. in Bathurst, N.B., and a tour of their facilities followed. The other was held in Ottawa in conjunction with the annual meeting of the Mining Association of Canada.

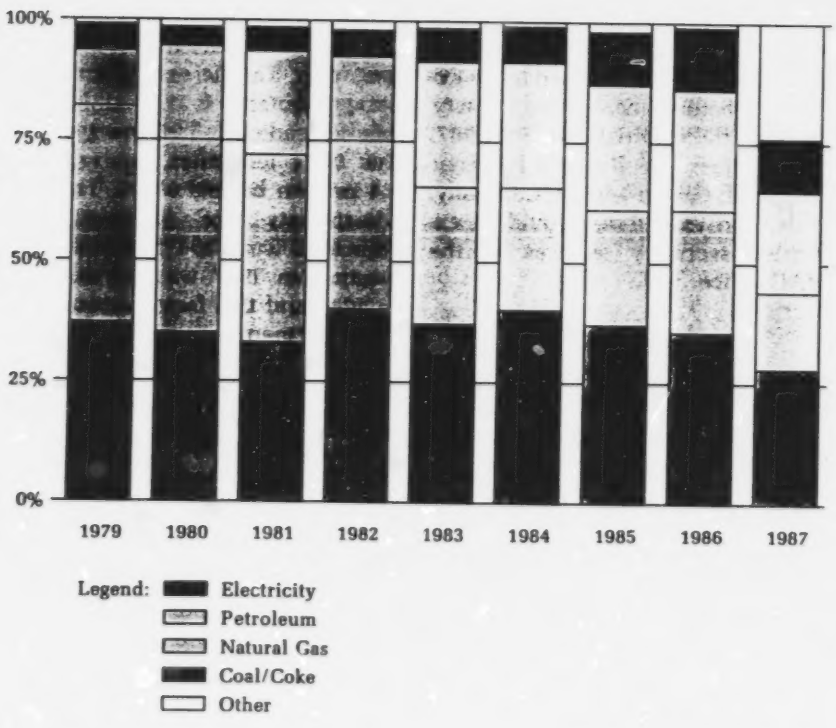
The task force maintains a "Manual of Case Histories" describing energy management activities undertaken by member companies. This manual is currently being updated. Abstracts are being written and a computerized index is being developed. New case histories will be published in the CIPEC newsletter as they become available.

Future Outlook

The program objectives of this task force will be broadened to keep pace with the changing energy management scene by:

- Increasing our involvement with the provincial energy ministries and federal department of Energy, Mines and Resources.
- Increasing membership and the number of companies reporting annual energy consumption statistics.
- Investigating further the issue of changing energy use by focusing particularly on energy intensities as they relate to other OECD countries.
- Orienting the task force toward a greater emphasis on technical activities.

Mining and Metallurgy Industry
Historical Energy Distribution



Mining and Metallurgy Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		133,146 terajoules
New base year (1985) equivalent energy inputs		141,340 terajoules
Gross Improvement = 5.79%		
Adjustments		304 terajoules
Adjusted base year equivalent		141,644 terajoules
Net Improvement = 6.0%		
Efficiency gain 1973 - 1985	9.6	
1986	–3.3	
1987	6.0	
Total gain 1973 - 1987	12.3%	

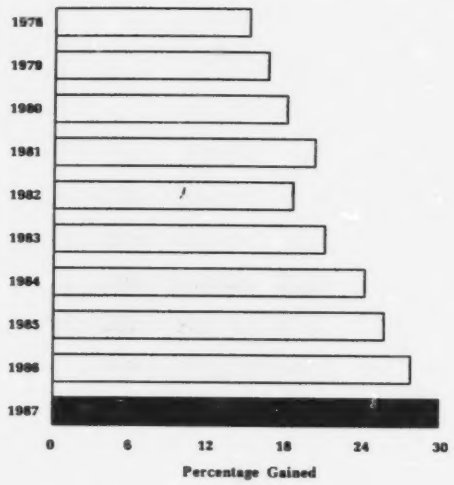
Mining and Metallurgy Industry
Energy Use

Type	Units	Terajoules	Percentage of Total Consumed
Natural Gas	656,860,215 m^3	24,435	18.4
Electricity	12,656,944 MWh	45,565	34.2
Liquid Petroleum Products			
Distillate Oil	24,228 kilolitres	945	0.7
Residual Oil	305,007 kilolitres	12,353	9.3
Crude Oil	529,551 kilolitres	22,400	16.8
Diesel	19,054 kilolitres	7,603	5.7
Gasoline	9,097 kilolitres	329	0.2
Coal	168,853 tonnes	5,420	4.1
Coke	247,133 tonnes	5,758	4.3
Other Fuels			
Propane	308,722 kilolitres	821	0.6
Others (hot water, steam)	n/a	7,517	5.7
Total		133,146	

Petroleum Refining Industry

Energy Conservation Task Force

Glen G. Myers
Chairman



The Petroleum Refining Industry Task Force established in 1977 continues to report on energy conservation progress in its sector. This report for 1987 is based on submissions from 10 companies which process in total about 90% of the crude oil upgraded and refined in Canada.

Major changes in the industry and in the energy monitoring facilities in use have made it necessary to adopt a more recent base year to accurately quantify recent improvements in energy consumption. The year 1985 has been selected as the new reference.

Energy Efficiency Improvement Progress

In 1987, the petroleum refining industry achieved a 4.9% net reduction in energy consumption relative to 1985. This energy reduction has been added to the 25.6% reduction achieved earlier during the period between the original base year (1972) and the new base year to show a consolidated gain of 30.5%, surpassing the 1990 goal of 30%.

The improvement was achieved in the face of a steady increase in processing intensity resulting from such factors as continued lead phasedown, increased product desulphurization requirements and further product mix changes. Without adjustment to equivalent 1985 operating conditions, the reduction achieved since 1985 was 3.5%.

Economic Factors Affecting the Industry

Most of the major energy conservation projects derived from process studies conducted in the early 1980's were completed by the end of 1987 and only a few large projects offering rapid returns on the investment are planned for implementation in the near future. Continued volatility in crude oil and product prices is complicating investment decisions regarding energy conservation and other projects. Until refining margins improve further, additional reductions in energy use will likely come from small investment projects and improvements in control and optimization of present facilities.

Any additional processing facilities needed to meet new government regulations will be designed for high energy efficiency, but will consume some additional energy and will limit the funding available for other projects, including energy conservation projects.

Specific Conservation Activities

1. Operations and Maintenance

   The reduction in energy use achieved in 1987 resulted partly from recently completed projects, and partly from continued improvement in operating and maintenance practices. Energy

conservation equipment installed in the mid-1980's reached the time of requiring additional maintenance and tuning. Areas of improvement included:

- Close attention to process settings by operators, supervisors, engineers and management.
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers.
- Continued emphasis on training operators and engineers.
- Increased furnace efficiency through combustion control improvements.
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning.
- Optimization of steam systems.
- Improvements in energy monitoring and control techniques.
- Application of process optimization techniques.

2. Capital Projects

Some capital investment in energy conservation work occurred in 1987, primarily in the following areas, with close attention paid to achievement of project goals:

- Heat recovery facilities, particularly in crude heat exchangers.
- Improvements in plant automation and control.
- Insulation upgrading.
- Reduction in steam consumption.
- Modifications to raise furnace and boiler efficiencies.
- Facilities to reduce fuel gas production.

3. Technology Improvements

Recent gains in energy efficiency have come partly through application of some of the latest advances in technology. The processes used to upgrade and refine crude oil are complex and the improvements easiest to implement were among the first to be installed. Accordingly, the industry has a strong interest in applied research and development to attain higher process efficiency. The industry maintains close relations with scientific and technology research activities worldwide. The types of new technology undergoing rapid development and application include:

- Improved catalysts and additives.
- Facilities to reduce crude oil and product losses.
- New techniques to increase heat recovery.
- Techniques to convert fuel gas components into liquids.
- Advanced computer control and process optimization techniques.
- Sophisticated data management systems.
- Use of high efficiency electric motors.
- Facilities for plantwide monitoring and control of electrical power.
- New types of on-line analyzers.
- Flare gas measurement and recovery.

Task Force Activities

The petroleum industry task force is led by two committees: a Steering Committee which sets policy, maintains government relations and establishes funding, and a Technical Committee which reviews industry reporting procedures, receives composite industry data and prepares the annual sector report. The Steering Committee is chaired by G.G. Myers, and the Technical Committee is chaired by N.J. Little.

To protect the confidentiality of data from individual sources, the offices and secretarial services of PACE (The Petroleum Association for Conservation of the Canadian Environment) are used to obtain and consolidate the technical data submitted by the participating refining companies. It should be noted that all costs involved in the activities of the task force are borne by the petroleum refining industry.

The sector does not consider itself as suitable to sponsor or conduct educational workshops. However, member companies are encouraged to participate individually in academic and industrial seminars on energy management and conservation.

Future Outlook

Improvements in operating and maintenance practices and implementation of small capital projects applying recent technological advances will continue to receive the strongest emphasis in the near term, and should yield appreciable additional improvements in energy use. In Ontario, introduction of time-of-use electricity rates will force development of steps to shift some electrical loads to the low-cost nighttime period.

In the longer term, larger capital expenditures will be required to make further significant progress in energy efficiency in petroleum refining. The investments will proceed if expected rates of return are adequate and capital funds are available. The highly competitive nature of the industry and the need to remain competitive will likely spur the drive toward higher energy efficiency.

Applied Conversion Factors

Crude Oil	37.660 GJ/m^3
Distillate	38.655 GJ/m^3
Residual	41.721 GJ/m^3
LPG	26.617 GJ/m^3
Natural Gas	38.414 MJ/m^3
Refinery Gas	36.886 MJ/m^3
Petroleum Coke	35.030 MJ/kg
Coal	27.935 MJ/kg
Purchased Steam	2.791 MJ/kg
Purchased electricity	10.551 MJ/kWh

Petroleum Refining Industry

Energy Use

Type	Petajoules	Percentage of Total Consumed
Natural Gas	52.1	17.8
Electricity (purchased) (a)	38.9	13.3
Liquid Petroleum Products		
Distillate Oil	0.3	0.1
Residual Oil	11.7	4.0
Petroleum Coke	58.0	19.8
Other Fuels		
L.P. Gas	2.6	0.9
Refinery Gas	127.0	43.4
Steam (purchased)	2.0	0.7
Total	292.6	

Energy based on (1) company assigned conversion values, (2) measured thermal values, or (3) U.S. Bureau of Mines

Energy Efficiency Improvement

Current year (1987) total energy inputs	292.6	petajoules
New base year (1985) equivalent energy inputs	303.3	petajoules
Gross Improvement = 3.5%		
Adjustments (for increased processing severity, changes in product mix, capacity utilization, etc.)	4.4	petajoules
Adjusted base year equivalent	307.7	petajoules
Net Improvement = 4.9%		

Efficiency gain 1972 - 1985	25.6
1986	2.0
1987	2.9
Total gain 1972 - 1987	30.5%

Composite Report for 10 Companies
January through December 1987

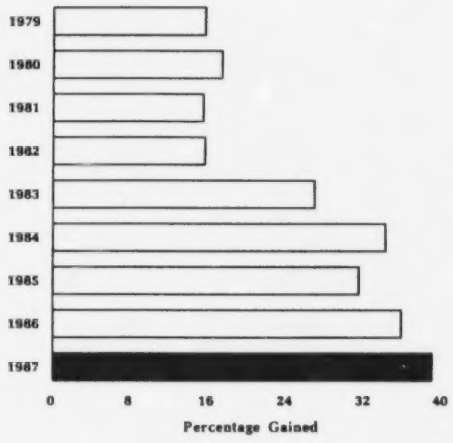
Line		MJ/m³ Input
1.	Total measured energy consumption, current reporting period	3,413
2.	Processing adjustments [1]	–
3.	Lead phaseout and higher clear mogas octane	13
4.	Increased desulphurization (tighter product specs and lower crude quality)	14
5.	Product mix changes	10
6.	Other processing adjustments	–3
7.	Major capacity additions	–1
8.	Processing of liquid, gaseous, and solid wastes	1
9.	Throughput effect	–4
10.	Miscellaneous	22
11.	Total adjustments (sum of lines 2-10)	52
12.	Current operations adjusted to operating conditions (line 1 minus line 11)	3,361
13.	1985 base period — total energy consumption	3,537
14.	Energy conserved in reporting period based on conservation steps implemented since 1985 (line 13 minus line 12)	176
15.	Per cent change from 1985 base period	4.9
16.	Total refinery input, 1985 base period	226.4 10^3 m³/d
17.	Total refinery input, current reporting period	234.9 10^3 m³/d

[1] Use calculated adjustment factors or Nelson complexity index of Δ 1 = 498 MJ/m³

Plastics Processing Industry

Energy Conservation Task Force

Ron S. Hayter
Chairman



This report is based on a survey of the processing sector of The Society of the Plastics Industry (SPI) of Canada, which represents companies engaged in all facets of the industry.

Plastics is now the fourth largest manufacturing industry in Canada with some 78,000 employees, and a Gross Domestic Product (GDP) of $10.1 billion. Its high GDP growth rate — 9.1 percentage points in 1987 — is due primarily to the cost-effectiveness and versatility of plastics. Some of the benefits inherent in its production, however, are the low-energy requirements for manufacture of a variety of highly specialized products and very efficient processing operations.

The companies represented by this survey are independent, high-volume processors utilizing the injection moulding, extrusion, blow moulding, fabric coating, and reinforced layup methods of manufacture. Raw material suppliers, distribution companies, and equipment makers are not included in the survey because of their totally different energy requirements. A large number of captive processors have also been omitted since their performance is incorporated in their parent organization's report to other task forces.

Three-quarters of the reporting companies show energy costs in the $100,000 to $500,000 range. In these firms, energy management is usually one of the many tasks performed by local plant managers or central operations managers. Energy monitoring is normally done as part of factory cost accounting on a monthly schedule.

One-quarter of the companies in the survey spend between $1 million and $2 million for fuel and electricity. These companies often have plant engineers dedicated to the task of improving operating efficiencies and controlling costs with the aid of computerized energy monitoring systems.

In general, productivity management throughout the plastics processing industry tends to be a "hands-on" entrepreneurial activity. As such, managers are attentive to up-to-date production and energy conservation techniques and tend to make decisions quickly, based on their knowledge of successes elsewhere in the industry.

Energy Performance

Energy utilization in the surveyed companies improved 3.6% in 1987, raising the overall gain since 1980[1] to 39.5%. At the current rate of im-

[1] Even though the Plastics Processing Energy Conservation Task Force was established in 1976, the consolidated reference time has gradually shifted up to 1980 as a result of constant changes in products.

provement the 50% goal set for 1990 should be achieved on schedule.

In 1987, it is estimated the 42 participants spent $11.9 million for electricity, while $4.7 million was spent for natural gas. Because of the improvement in energy utilization, the participants saved over $1 million in manufacturing expense during the year. This will most likely go towards expansion of their businesses.

Energy costs generally vary between 9 to 12% of total manufacturing expenses in the extrusion and blow moulding processes. The energy intensities and costs are somewhat lower in the filmmaking and coating sectors, however, where percentages between 2 and 6% were reported.

Factors Impacting on 1987 Performance

Business conditions were excellent throughout the industry in 1987. There was a 9.1 percentage point increase in GDP, continued operation at full capacity, and investment of some $382 million for new plants and equipment. In the past, when such buoyant operating conditions prevailed, energy efficiency gained in the 5.6 to 5.9% range.

In 1987, however, because of the widespread expansion activities and extremely busy staff, many of the usual participants could not take part in this year's survey. As a result, the 3.6% gain reflects a different mix of somewhat smaller companies, many of whom are reporting for the first time.

One of the most frequently mentioned energy conservation improvements again this year was the recovery of waste exhaust heat. For many companies this has meant installing recuperators in the boiler stacks. For others, it involved collecting heat from process equipment and ducting it into adjoining plant locations. However, a few companies reported that even after these improvements were made they still have a surplus of heat that must be exhausted.

Another common energy conservation action is the installation of electrical-demand-limiting controls and power-factor-correction equipment. These techniques are popular in the injection and blow moulding businesses where the pulsing types of machines cause variable demands for power. One company also mentioned that it made extensive revisions to its air compressor system to lower the electrical power requirement.

More generally, companies have increased productivity by installing state-of-the-art equipment in their plants. The benefits achieved from innovative R&D on new mould designs, raw material preheating systems, compounding and alloying of new materials, and statistical quality control methods, etc., have led to longer production runs and higher product standards.

The trend toward dedication of products exclusively to new highly automated plants or in rationalized locations is continuing to add exceptional efficiency gains for some companies. In these cases, there is frequently less raw material and finished product handling which minimizes warehousing requirements.

A surprising number of comments arose this year from energy managers' growing attention to electrical matters. For example, several mentioned problems with line voltage dips, "spikes", and harmonics, which are triggering more frequent shutdowns of sensitive production equipment, costly production losses and sometimes damage to computerized controls. Others expressed displeasure with high demand charges and the monopolistic attitudes emanating from their electrical utilities. In contrast, these energy managers are pleased with the results of deregulated natural gas prices and the consequent competitive spirit.

Future Outlook

With steady growth in product demand, continued high levels of investment in modern equipment, aggressive application of leading-edge technologies, and maturing energy management techniques, the future of still greater unit-energy savings is exceedingly bright. However, accelerating energy prices and changing utility cost structures, e.g., introduction of electrical "time-of-use" rates, will intensify the need to focus more attention on energy management issues in order to maintain a competitive advantage.

Energy Use Patterns

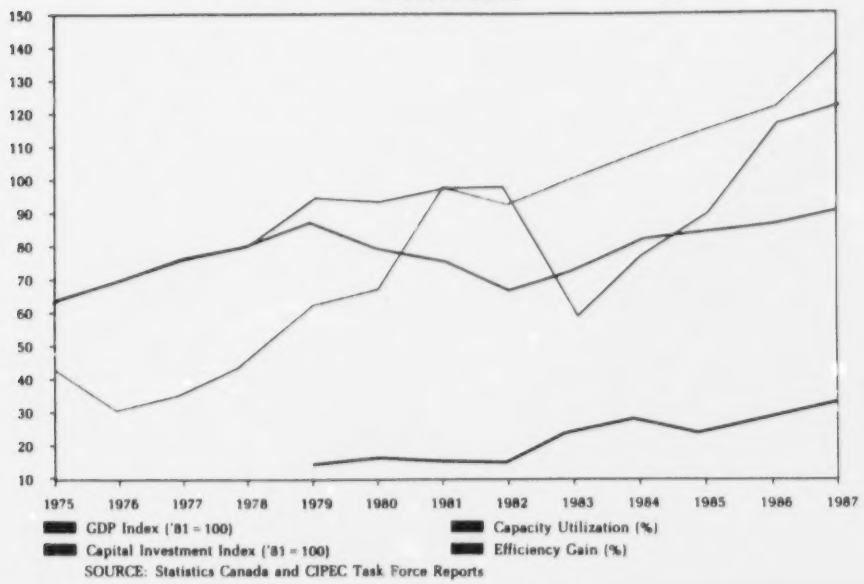
Minor variations in the shares of purchased energy are caused more by changes in the reporting population than by fuel switching or technological factors. Most plastic processing companies are centred around the large urban centres where natural gas is well established as the most convenient and economical source of fuel for plant heating.

A few companies located near Montreal are known to have switched to electric radiant heating for their plants as a result of attractive incentives provided by Hydro-Quebec, but these isolated cases are not evident in the group trends.

In the Ontario locations, large cost savings have been realized through competitive marketing of deregulated natural gas which has helped drive down prices of other fuels as well. However, there was no detectable fuel switching in 1987 as a result.

Plastics Processing Industry

Performance



SOURCE: Statistics Canada and CIPEC Task Force Reports

Plastics Processing Industry

Energy Efficiency Improvement

Current year (1987) total energy inputs		2,096.1 terajoules
New base year (1985) equivalent energy inputs		2,278.2 terajoules
Net Improvement = 8%		
Adjustments — None		
Efficiency gain 1980 - 1985	31.5	
1986	4.4	
1987	3.6	
Total gain 1980 - 1987	39.5%	

Plastics Processing Industry

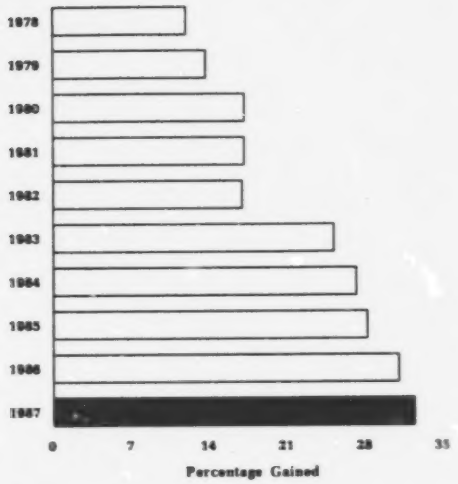
Energy Use

Type	Units	Terajoules	Percentage of Total Consumed 1987	1986	1983	1982
Natural Gas	26,589,180 m^3	989.1	47.2	53.0	49.8	53.9
Electricity	288,326 MWh	1,037.9	49.5	42.5	48.8	43.5
Liquid Petroleum Products						
Distillate Oil	241,139 litres	9.4	0.5	1.0	0.6	1.3
Residual Oil	1,097,027 litres	44.4	2.1	3.0	0.4	—
Diesel and Gasoline	136,154 litres	5.4	0.3	0.2	—	—
Other Fuels						
Propane	371,903 litres	9.9	0.4	0.3	0.4	1.3
Total		2,096.1				

Pulp and Paper Industry

Energy Conservation Task Force

H. Dave Paavila
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 61 companies with 126 mills accounting for about 98% of the total pulp, paper and paperboard produced in Canada in 1987. Five of the mills included in the report are not members of the Association.

Energy Use Efficiency

In 1987, the Canadian pulp and paper industry used 33.1% less purchased energy per ton of product than was used in the base year 1972. This continuing improvement in energy use efficiency is in part attributable to the record operating rate achieved by the industry in the year. Production increased by 34.1% over the base year.

The trend in diminishing reliance on fossil fuels reported in last year's report continues. The major energy source is still purchased electricity which accounts for 47.9% of the total purchased energy. Heavy fuel oil has shrunk to 21.6% of the total, which is 29% of the amount used on an equivalent production basis in 1972. On a unit energy basis, electricity increased due to electric boilers in Quebec and increased motive power requirements of mechanical pulping processes which are gradually replacing sulphite pulps, especially in the newsprint sector.

The reduction in heavy fuel oil use is equivalent to 3.98 billion litres, and in total purchased energy use is equivalent to 3.78 billion litres of heavy fuel, in 1987.

Operating Conditions

As noted above, production for the year 1987 was a record one for the industry. Shipments of pulp and paper by the Canadian industry rose by 5% over 1986, with printing, writing and sanitary grades showing the largest increase. The industry as a whole operated at 98% of capacity for the year, with only small losses of production due to work stoppages. Accompanying this increased output, profits also improved. However, given the large number of projects for modernization, productivity improvement and quality improvement, and more fossil fuel prices which are currently applicable, energy conservation projects will continue to be given lower priority than in the late 1970's.

Use of wood wastes generated by the industry levelled off during the past year and now account for 68% of the total fuels burned by the industry. Waste fuels plus captive hydraulic power account for 57% of the total energy used, up from 42% in 1972.

Technological Developments

The Thunder Bay, Ontario, mill of Great Lakes Forest Products Limited

was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1987. Steam leakages through pressure reducing valves, totalling 26,000 lbs./hour, were identified using a computer program that calculates the mass balance in the news mill steam supply system. Because not all flow meters are provided with pressure reducing valves, the leakages were identified inferentially. The mass balance program, which was developed as a joint venture between Great Lakes Forest Products Limited and Fleming Systems Corporation, is run daily to verify the operation of the turbines and bypass systems. For an identical process steam demand, an increase in electrical generation of one megawatt was realized for a monthly saving of about $23,000. The cost of the software development was approximately $10,000.

The Technical Section's Energy Conservation Awards Program has now generated a total of 379 case studies, which have been published for distribution throughout the Canadian industry.

In a project funded by Environment Canada, the technical and economic feasibility of drying pulp and paper mill sludges was assessed by PAPRICAN. A literature survey indicated that several recent generation screw presses are only capable of dewatering a variety of pulp and paper mill sludges to 40-50% dryness. Because of this limitation, efficient drying techniques are being investigated.

One such technique which appears to be promising is direct drying with oil as the heat transfer medium and vapour recompression as the source of heat. The concept has been proven on full-scale with secondary pulp mill sludge. Furthermore, the concept has been technically proven at PAPRICAN on a pilot scale with hog fuel.

A conceptual adaptation of the oil-drying process for primary newsprint mill sludge was provided outlining the major equipment required to carry out the process. Detailed capital and operating cost saving estimates were derived for newsprint mill sizes of 330, 660, 1000 and 1300 tonnes per day (t/d). The total capital investment, including installation but excluding a new building or shelter, was approximately $1.1, $1.5, $2.0 and $2.3 million respectively for the above mill sizes. The net operating cost savings are a result of oil savings from additional steam production from the dried sludge, and savings on disposal of sludge as land fill.

Profitability analysis of the process was carried out by calculating the discounted-cash-flow rate-of-return (DCF-ROR) at various oil prices and sludge disposal costs. At a typical sludge disposal cost of $30/odt sludge and the presently prevailing oil price of approximately $25 CDN/barrel ($19 US/barrel) for newsprint mills of over 660 t/d capacity, the estimated payback period would be three to four years with an after-tax DCF-ROR of 17 to 25%. At only 20% higher oil prices, i.e. $30 CDN/barrel, the payback period improves to two to three years. In a partly government-funded project, also at PAPRICAN, the use of heat pumps for waste heat recovery in the pulp and paper industry has been studied.

While, in general, there is vast potential for the application of a high temperature heat pump (HTHP) in a variety of pulp and paper making operations, the actual application is mill specific. In an integrated mill with a high degree of recycle, it requires simulation of the whole mill. It often requires modifying the mill in order to get higher heat pump source temperatures. Steam produced by a HTHP, besides requiring to be an economical operation, must be justified with respect to end-use and other potential heat recovery schemes, such as a heat exchanger network.

Economic evaluations on five R114 HTHPs were performed. Two Canadian Stone Groundwood SGW-based newsprint mills were studied and the potential for installing a R114 HTHP with subsequent steam compression with a heat capacity of over 40 GJ/h was assessed. In the first case, a R114 HTHP coupled to a mechanical steam compressor gave a payback period of 6.6 years and an after-tax discounted-cash-flow return-on-investment (DCF-ROI) of 9.7%. The mill was not typical since it had cogeneration and this precluded the use of high pressure steam to be used in a steam jet thermocompressor. In a second case study, the mechanical steam compressor could be replaced with a steam jet thermocompressor. The economic returns were substantially improved to a 4.2 years payback period and 15.7% DCF-ROI.

Pulp and Paper Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		318.98 petajoules
Base year (1972) equivalent energy inputs		477.18 petajoules
Net Improvement	= 33.1%	
Adjustments — None		
Efficiency gain 1972 - 1985	28.3	
1986	2.8	
1987	2.0	
Total gain 1972 - 1987	33.1%	

In the case of the kraft mill, the end-use had a temperature low enough not to require the use of a steam compressor. A typical bleach plant operation was described and, similar to the SGW-based newsprint mills, it was found that the application of a R114 HTHP was more favourable with higher degree of closure. The DCF-ROI was 11.9% and the payback period 5.5 years.

The kraft digester blow heat study yielded the best results. The payback period was 3.5 years and DCF-ROI 18.5%. This was a result of the combination of a relatively large HTHP (36 GJ/h) with a high Coefficient of Performance (8.6).

In another partly government-funded project at PAPRICAN, ways of reducing the amount of energy used by paper and pulp machine dryer sections are being considered.

The drying sections of Canadian newsprint machines were studied and it was found that there was a great variation in energy consumption in these operations. Also, it was concluded that there is considerable potential for energy savings through heat recovery and by reducing the amount of blow-through steam.

Following a study of the drying sections of market pulp machines, it has been determined that a similar amount of energy is used for pulp drying in air flotation and cylinder dryers while the flash dryers are more energy efficient. Also, a study of drying sections of machines producing four grades of paper and board revealed that, compared with newsprint, these grades require more drying energy, mostly because of less efficient pressing.

An energy audit of the dryer sections of one old and one new newsprint machine has been completed. It has been determined that the better energy economy of the new machine is due to a more efficient heat recovery system.

An easy method for carrying out energy audits of dryer sections has been developed and is being made available to mills.

In a Quebec government-funded project that is being conducted within the McGill University Chemical Engineering Department post-graduate program in conjunction with PAPRICAN, the process engineering fundamentals in flow and contacting processes are being studied to develop an understanding of transport phenomena and materials properties for processes involving fluid-solid interaction.

Energy aspects of this work include the development of new techniques for drying. In this context, research is being carried out on the SWIFT Drying Process, i.e., superheated steam with impingement and flow through.

It has been determined that for paper dried in superheated steam, the properties measured are equivalent to or better than the same paper dried conventionally.

The Future

The Canadian pulp and paper industry's energy conservation target for 1990 is a 33% reduction in purchased energy use per ton of product, compared with 1972. This target was achieved in 1987.

Pulp and Paper Industry
Purchased Energy Consumption

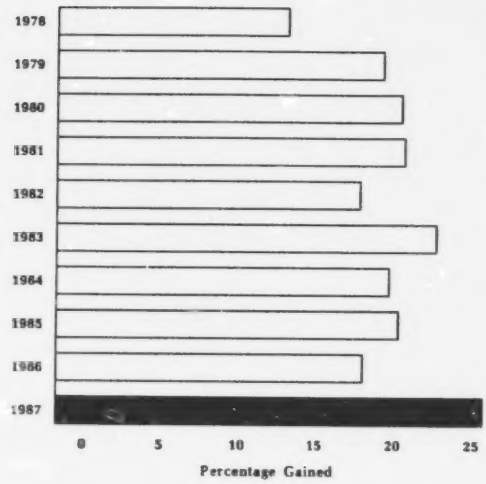
Type	1987** Petajoules	Percentage of Total	1986** Petajoules	Percentage of Total	1972* Petajoules	Percentage of Total
Natural Gas	85.26	26.7	80.74	25.9	95.70	20.1
Electricity (purchased)	152.79****	47.9	148.42***	47.5	115.09	24.1
Liquid Petroleum Products						
Distillate Oil	4.72	1.5	4.96	1.6	8.71	1.8
Residual Oil	69.01	21.6	69.97	22.4	235.26	49.3
Coal	4.77	1.5	5.97	1.9	16.55	3.5
Other Fuels						
L.P. Gas	0.78	0.3	0.73	0.2	0.95	0.2
Other	1.65	0.5	1.50	0.5	4.92	1.0
Totals	318.98	100.0%	312.29	100.0%	477.18	100.0%

*Reported on 1972 unit use adjusted to 1987 production
**Actual Use
***33.75 petajoules (10.8%) used in electric boilers
****32.91 petajoules (10.3%) used in electric boilers

Textile Industry

Energy Conservation Task Force

Luis G. Monton
Chairman



Energy efficiency improved in the primary textile industry by an impressive 6.8% in 1987.

The Textile Industry Energy Conservation Task Force, in conjunction with the Canadian Textiles Institute, shows the successful efforts of primary textile manufacturers to reduce energy consumption during the production and processing of both natural and man-made fibres and fabrics. These chemical and physical processes include knitting, spinning and weaving, dyeing and printing, bleaching, blending, brushing, tufting and twisting.

When Canadians think of textiles they usually think of the clothes they wear or the carpets they walk on. This is a misleading image of the primary textile industry which can and does produce material with five times the strength of steel. Textiles are used to produce body armour for policemen, reinforce airport runways and provide the structure for car tires.

In 1987, the primary textile industry produced over $6.1 billion worth of product. The majority went to supply more than 150 manufacturing industries. Less than half the total output of the mills was sold to apparel manufacturers. Textiles form a vital part of the equipment used in the mining, forestry and fishing industries.

Some 63 leading establishments participating in the task force produce 90% of Canada's primary textiles. Apart from the companies which sell exclusively to other industries, the primary textile industry also includes those which produce finished products such as knitwear, drapes, carpets, blankets and towels for domestic consumption, as well as export.

Performance: A Good Year For Textiles

Energy efficiency in this industry improved by 6.8% during 1987. When this figure is added to the improvement made between 1974 and 1985, the total energy improvement comes to 26.6%, already within 2.4% of the 1990 target set by the Textile Task Force.

This is remarkable when the amount of imported greige fabric, which was a factor in the negative 2.3% figure for 1986, is taken into account. Greige imports were up by 79% in 1987. Greige goods are fabrics which must still be dyed and processed. These are "wet" processes which sometimes need three to four times more energy per kilo of product than other textile processes.

The increased efficiency rating for 1987 was based largely on capacity utilization in the textile mills, aided by the unexpectedly strong performance of the national economy which showed a growth of 3.8% in GDP. In relation to the manufacturing sectors which showed an

annual combined growth of 2.1%, primary textiles posted a 6.7% increase.

Driven by intensifying import competition, the primary textile industry is now concentrating on maximizing production. While new technologies are constantly being analyzed for energy efficient application in the industry, their implementation is limited by the need for short-term paybacks.

Consequently, most energy gains are still being made in housekeeping and in the techniques of maintenance. Projects being put forth are concentrating on areas where substantial gains can be achieved without incurring heavy capital costs.

The Textile Energy Conservation Task Force publishes two sets of documents: one stresses the need for increased energy efficiency, the other provides a networking effect for managers who are charged with increasing their plant's operational efficiency.

"Energy Conservation Notes" is a newsletter which has been used as a model by other CIPEC task forces and carries the message that energy efficiency results in a better bottom line. It also provides a roundup of energy efficiency news and the application of new techniques. "Energy Conservation Techniques", its sister publication, provides case studies demonstrating specific ways in which greater efficiency can be obtained.

While these two publications are addressed primarily to the men on the floor and to energy managers, the task force is now launching a pilot project on how best to bring home the energy efficiency message to busy CEOs.

This task force stresses energy "efficiency" over energy "conservation." Conservation as a concept has a negative connotation. Efficiency, on the other hand, relates directly to the positive concern of senior management about building that better bottom line.

During 1987, the Textile Energy Conservation Task Force, through its Technical Liaison Subcommittee, organized two seminars, one in English, the other in French, on heating, ventilation and air conditioning. The excellent technical teaching manuals of Energy, Mines and Resources (EMR) formed the basis for the sessions which were augmented with textile case studies.

Both seminars were well attended by energy managers and the consensus of the attendees was that the hands-on approach was the best way to impart effective information. This can best be illustrated by the fact that during the case study portion of the seminars attendance was at its highest.

For 1988, in keeping with the objective of making the greatest energy gains with the least costs, the Technical Liaison Subcommittee is planning to hold two seminars, one in English and one in French, on the subject of steam. The seminars will deal with auditing, water treatment, steam traps, housekeeping, installations and retrofits.

Once again, EMR's technical manuals will be used as base material and the subjects will be given textile application by industry case histories. As well as industry professionals, technical colleges will be invited to send students to the seminars so that a new generation of industrial personnel will appreciate the values of energy management.

Case History

Bleaching, dyeing, printing and sanforizing are textile processes which consume great amounts of energy.

After exhaustive study and analysis by one large organization, it was suggested that energy savings could be made in four ways. Of these, three of the methods provided extremely short payback periods — less than one month in two cases and one month in the third. The fourth project required a payback period of five years.

The first project involved the reduction in volume of combustion products and the fabric humidity exhausted outside the plant during the drying process. Exhaust was reduced from 14,000 cubic feet per minute (CFM) to 9,000 CFM without any consequent loss in quality. The costs were negligible as the modifications only involved changing a few pulleys. The savings are substantial and continuing — $28,000 a year.

Project number two involved modifying the way that hot air was used during the drying process. Automatic controls were installed which allowed one fan to turn off after its initial use and the capacity of the remaining fan increased. This reduced the total volume of exhaust air being circulated from 9,000 CFM to 6,000 CFM per machine. The cost of the modifications was insignificant but the savings — $14,000 per year.

The third project involved installing automatic burner controls to turn down the temperatures during production interruptions. These modifications were also done at low cost and for savings of $10,000 per year.

The fourth project involved the installation of a Krantz air-to-air heat exchanger which recovers more than 50% of the energy contained in the drying process exhaust. The installation cost $70,000 in 1983 and provides an annual saving of $15,000. It should be noted that if the heat exchanger had been installed at the time of range construction, the cost would have been only $40,000 and the payback period reduced from five years to three.

Except for the installation of the heat exchanger, all the modifica-

Textile Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		9,285,403 gigajoules
New base year (1985) equivalent energy inputs		9,722,935 gigajoules
Net Improvement = 4.5%		
Adjustments — None		
Efficiency gain 1974 - 1985	22.1	
1986	–2.3	
1987	6.8	
Total gain 1974 - 1987	26.6%	

Textile Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed 1987	1986
Natural Gas	136,258,000 m^3	5,068,798	54.6	52.5
Electricity	943,559 MWh	3,396,812	36.6	36.7
Liquid Petroleum Products				
Distillate Oil	287 kilolitres	11,193	0.1	0.1
Residual Oil	17,184 kilolitres	726,883	7.8	9.8
Diesel and Gasoline	421 kilolitres	16,019	0.2	0.2
Other Fuels				
Propane and LPG	1,600 m^3	42,560	0.5	0.5
Other Gaseous Fuels	460 m^3	23,138	0.3	0.2
Total		9,285,403		

tions to cut energy consumption at this plant involved minor adjustments and modifications. The message is clear: energy efficiency can be found in both large and small applications.

Energy Use Patterns

Natural gas at 54.6% (up 2.1%) still provides most of the energy used. Electricity provides 36.6%, heavy oil 7.8%, with other energy sources providing less than 1%.

Outlook and Concerns

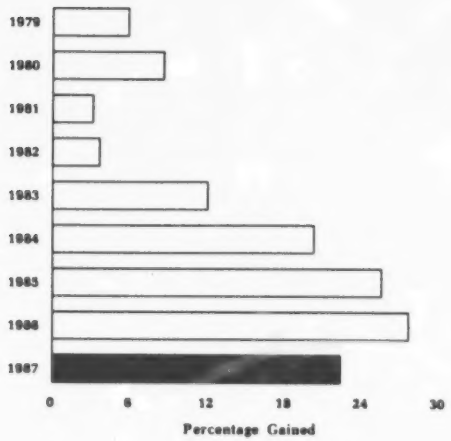
While the primary textile industry has now come close to its 1990 goal for efficiency gains, the ongoing concern is maximizing production. Temporarily, low fuel prices have reduced some interest in energy efficiency. The task force realizes that in this situation the best way to promote energy efficiency is to concentrate on the ways in which energy gains can be made at negligible costs.

For these reasons it is continuing its seminar and publication programs, and at the same time studying how to revive energy efficiency consciousness, particularly among chief executive officers.

Transportation Industry (Manufacturing)

Energy Conservation Task Force

George Heidebrecht
Chairman



Task Force Profile

The Transportation Industry (Manufacturing) Task Force was established in 1975 to promote energy management and conservation among the membership of six participating trade associations.

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers Association (APMA)
- Canadian Shipbuilding and Ship Repairing Association (CSSRA)
- Canadian Truck and Trailer Manufacturers Association (CTTMA)
- Motor Vehicles Manufacturers' Association (MVMA)

These six trade associations represent 439 companies of various size. Although only 58 companies reported for 1987, they do, however, use 80% of the total energy consumed by the transportation sector. Those reporting are, in general, larger companies which practise organized energy management and conservation.

Task Force Activities

The task force, in order to revitalize interest in the importance of proper energy management and conservation, embarked on a promotional campaign.

A professionally designed "Energy" brochure was mailed to the Chief Executive Officers of all 439 companies. It stresses the importance of proper energy management and encourages task force participation. The response is presently being evaluated and future mailings are planned. The next, to the company energy contacts, is scheduled for early Fall 1988.

In addition, the data collection forms will be simplified and, under consideration, is the use of the services of a retired task force committee member to assist companies with their energy auditing and data collection.

The "Idea Exchange" letter has retained its popularity and is distributed to approximately 1,000 companies.

During 1987, task force meetings continued on a regular basis. The topics for discussion ranged from energy management ideas to government policies and the continuously fluctuating fuel prices.

Promotion of energy management and participation in this worthwhile program will remain the primary goals of the task force.

Energy Use Patterns

The energy use table illustrates the distribution of the various types of fuel.

A definite shift from residual oil (No. 6 Oil) to natural gas, and a slight but steady increase in the use of electricity are indicated.

Since 1980 the share of residual oil has dropped from 14.7% to 1.7%, while the share of natural gas has risen from 49.1 to 56.7%.

At the same time, the share of electricity has increased from 23.6 to 32.8%. As plants become more and more automated, electricity, because of its ease of control, will gain in popularity.

As we are presently experiencing a drastic reduction in the price of natural gas, a steady increase in the cost of electricity and fluctuating oil prices, it remains to be seen what the future trend will be.

Performance

During 1987, compared with the adjusted base year of 1985, the task force incurred a deficiency of 3.3% instead of the anticipated 2% improvement in efficiency.

We believe this deficiency is the result of reduced priority and emphasis on energy management due to lower gas and oil prices, reduction in production volumes and the use of hi-tech, but highly energy-intensive equipment.

The reduction in production volumes and the installation of hi-tech equipment are the result of offshore competition. Plant changeovers resulting in zero production for as long as one year have also had a negative effect on energy efficiency. Further reasons for negative reports is the fact the production volumes and quality, in order to meet customer demand, are given priority. Also, with the present emphasis on industrial hygiene (e.g., plant air quality), very energy-intensive HVAC equipment is being installed.

Subsector Performance

The sector performance table indicates an excellent one year improvement of 5.2% by the Aerospace Industries' Association.

The Canadian Shipbuilding and Ship Repairing Association also reports an excellent one year improvement in efficiency of 15.2%.

The Automotive Parts Manufacturers' Association reported a 3.9% improvement.

The deficiency in improvement of 6.6% reported by the Motor Vehicle Manufacturers' Association, the task force's major energy consumer, indicates the direct result of offshore competition.

The task force committee is confident that the planned activities of direct contact with companies of the Allied Boating Association and the Canadian Truck and Trailer Manufacturers' Association will improve participation.

Future Outlook and Concerns

All indications are that, in 1988, we will not enjoy a healthy economy similar to that of 1986 and part of 1987. Thus, being faced with the ever increasing onslaught of offshore competition, we must, in order to regain a healthy economy, continue to improve our productivity and energy management.

The results of the 1987 data collection and the declining participation by the various task force subsectors indicate a reduced emphasis on energy management. This could be the result of low gas and oil prices, overloaded company staff, or higher priority business issues.

In view of the above, the Transportation Industry Task Force remains confident that, using 1985 as the base year, the goal of a 35% improvement in energy efficiency by 1990 is still within reach.

Transportation Industry
Energy Efficiency Improvement

Current year (1987) total energy inputs		40,148,007 gigajoules
New base year (1985) equivalent energy inputs (adjusted)		38,865,967 gigajoules
Net Improvement	= –3.3%	
Efficiency gain 1978 - 1985	25.6	
1986	2.1	
1987	–5.4	
Total gain 1978 - 1987	22.3%	

Adjusted base year inputs are the reflection of changes in weather, volumes of production, changes in manpower and changes in manufacturing areas.

Transportation Industry
Energy Use

Type	Units	Gigajoules	Percentage of Total Consumed						
			1987	1986	1985	1984	1983	1982	1980
Natural Gas	611,930,904 m^3	22,763,830	56.7	55.7	54.7	54.1	52.1	53.0	49.1
Electricity	3,657,904 MWh	13,168,454	32.8	30.7	30.1	29.3	28.4	26.9	23.6
Liquid Petroleum Products									
Distillate Oil	6,261,981 litres	243,542	0.6	1.3	1.2	1.2	1.4	1.8	0.7
Crude Oil	n/a	—	—	0.2	—	—	—	—	—
Residual Oil	15,696,384 litres	663,957	1.7	1.8	2.1	3.6	6.3	7.5	14.7
Gasoline	667,750 litres	29,733	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	877,687 litres	35,020	0.1	0.1	0.2	0.3	0.2	0.4	0.3
Coal	28,152 tonnes	903,679	2.2	3.5	3.5	3.8	4.0	3.9	5.9
Coke	95,033 tonnes	2,214,269	5.5	6.1	7.4	7.3	7.2	5.6	5.1
Other Fuels									
Propane	3,548,196 litres	94,382	0.2	0.5	0.6	0.3	0.3	0.4	0.4
LPG	125,650 litres	31,141	0.1	—	—	—	—	—	—
Total		40,148,007							

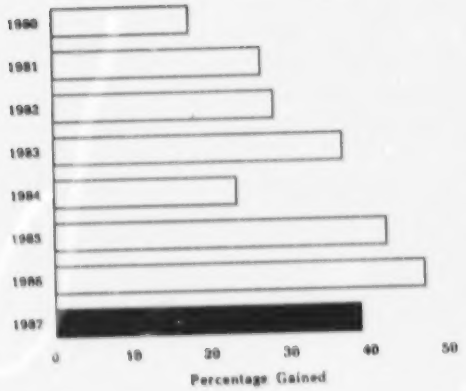
Transportation Industry
Energy Efficiency

Subsector	Base Year 1985			Base Year 1978					
	1987	1986	1985	1984	1983	1982	1981	1980	1979
ABAC (Boating)	—	—	—	12.9	3.1	-48.5	-88.1	—	-0.7
AIAC (Aerospace)	5.2	5.2	20.6	7.9	7.3	3.9	-43.7	6.0	-1.2
APMA (Autoparts)	3.9	2.7	6.5	13.5	11.7	5.8	26.7	15.6	3.3
CSSRA (Shipbuilding)	15.2	-19.4	11.4	-2.9	-10.6	-21.1	48.8	-14.1	-9.0
CTTMA (Truck/Trailer)	9.0	—	-26.3	-15.4	-56.9	-65.2	25.6	-18.1	-0.2
MVMA (Motor Vehicles)	-6.6	2.0	28.8	22.8	-6.3	3.3	—	—	—
Task Force	-3.3%	2.1%	25.6%	20.3%	1.2%	3.7%	3.2%	4.5%	0.4%

Wood Products Industry (Western)

Energy Conservation Task Force

R.C. Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Cariboo Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 44 operating sawmills owned by 22 companies, which accounted for 36% of all the lumber produced in B.C. in 1987. The reporting sample covers mills of all sizes and represents all regions of the province.

Goals and Progress to Date

The industry's goal for 1990 is a 7% overall increase in energy efficiency from the 1985 base year performance. However, the industry's overall energy efficiency in 1987 declined from the level achieved last year and, based on the current sample of reporting companies, the 1987 results were still a 38.9% improvement over the 1978 performance.

Average electrical energy consumption for the production of green lumber lost ground in 1987 and was almost 2% more than in 1985. Compared with 1978, however, the 1987 performance represented a 17.5% improvement.

The average natural gas consumption in the kiln drying of lumber in 1987 was up by over 8% compared with the 1985 level. When compared with the 1978 consumption, the 1987 performance represented a 50.5% improvement.

Although the sample of reporting mills in 1987 accounted for the same percentage of lumber produced as in 1985, unfortunately there were significant differences in terms of the actual mills which responded to the survey. The results are sensitive to changes in reporting patterns among mills, particularly those in the past which used natural gas-fired kilns to dry their lumber but then converted to using sawmill residues. Such a conversion does not require purchased fuel in the drying of lumber. In subsequent years this is reflected in a significant improvement in energy efficiency for the sector, provided that the mill continues to respond to the survey. Unfortunately, not all do and even

those which do continue to report do not do so every year. This largely explains the apparent increase in natural gas use, since mills do not normally convert back to natural gas after using sawmill residues.

The marginally higher use of electricity in 1987 compared with 1985 may, to some extent, reflect the difference in samples but may also be explained by record production levels attained in 1987. Mills operating at very high output levels are likely to be focusing on maintaining throughput rather than conserving energy.

At the beginning of 1987 the industry saw a 15% export charge imposed on lumber destined for the U.S. market. The export tax was enshrined in a more permanent way through an increase in stumpage charges and other forest management costs totalling approximately $600 million per year commencing in October 1987. While these increased charges can be borne by the industry during this period of relatively good markets, concerns are being voiced about the impact of such charges when markets again become depressed.

Neither B.C. Hydro electricity rates nor natural gas prices rose in 1987 for the industry. In fact, natural gas prices declined dramatically for large industrial users, such as pulp mills and somewhat less dramatically for the sawmill sector. This lessened the incentive for sawmills to convert to burning residues.

Task Force Activities

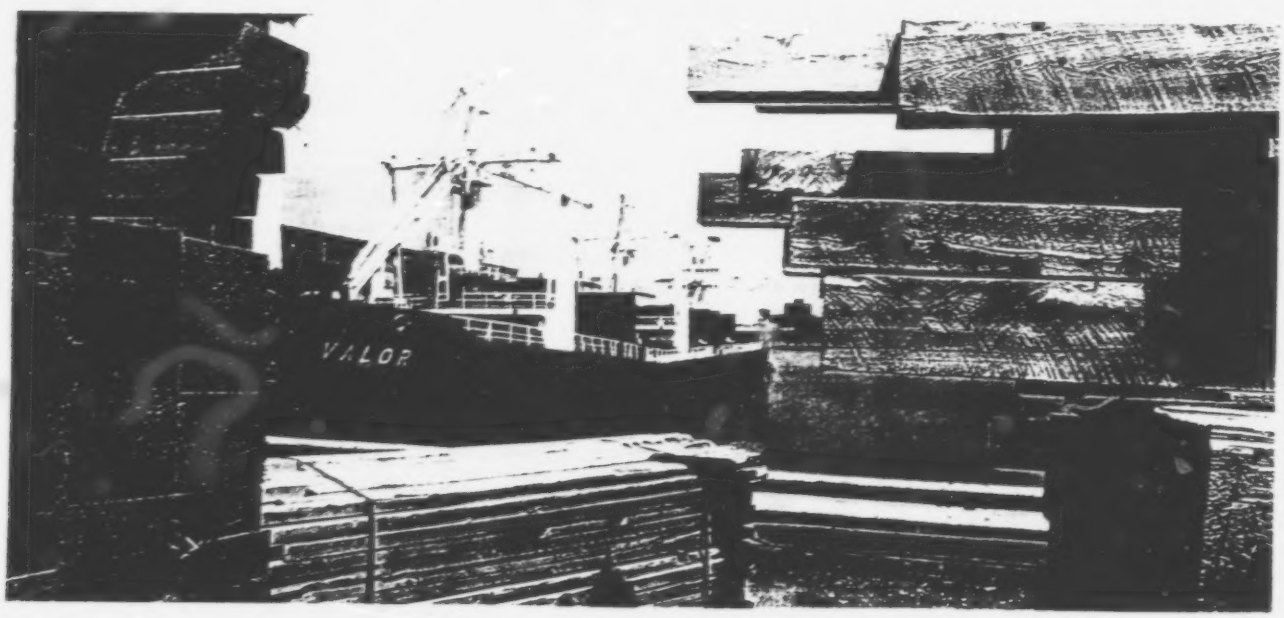
Higher levels of production have meant a modest increase in employment in most companies. Productivity-enhancing investments and improved operations techniques have, however, held increases in staffing to a minimum. It should become easier to reactivate the task force as staffing levels increase.

In 1987, COFI staff continued to disseminate information regarding conservation activities to member mills and to monitor the energy performance of the sector.

Future Outlook

Despite significant improvements in off-shore lumber markets and in other sectors of the forest industry, North American lumber markets appear to be softening marginally. Housing starts are generally expected to decline in 1988, but lumber consumption may not be seriously affected providing the decline is not too heavily focused in single-family starts. Other uses for lumber continue to grow in North America. Also, off-shore sales are expected to remain firm for the short-term but are dependent on continuing modest levels of economic growth and favourable exchange rates.

The uncertainties in lumber markets provide few incentives for major energy efficiency-type investments. Similarly, the lowering of natural gas rates is likely to continue for a number of years as groups of sawmills negotiate direct purchase agreements with natural gas producers and add to those savings through transportation service agreements with pipelines. These events make it difficult for sawmills to justify major natural gas-saving investments at this time.



Wood Products Industry (Western)
Energy Efficiency Improvement

Green Lumber	1987	1985	1978
Total sample production (million board feet — MMFBM)	5661.0	5052.0	4202.2
Total energy consumption (10^{12} J)	2554.3	2241.5	2297.7
Average electrical energy consumption (10^{9} J per MFBM)	0.451	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	2554.3	2241.5	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)	2511.7		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	3095.3		

Improvement (1985 base year) = –1.7%

Improvement (1978 base year) = 17.5%

Kiln Dried Lumber	1987	1985	1978
Total sample production (MMFBM)	3395.4	3159.4	1013.0
Total energy consumption (mainly natural gas) 10^{12} J	2833.5	2433.0	1708.8
Average energy consumption (10^{9} J per MFBM)	0.835	0.770	1.687
Current year total energy inputs (10^{12} J)	2833.5	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	2614.7		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	5724.9		

Improvement (1985 base year) = –8.4%

Improvement (1978 base year) = 50.5%

Combined Energy Performance	1987 Actual	1985 Equiv.	1978 Equiv.
Total electrical energy consumption (Green Lumber 10^{12} J)	2554.3	2511.7	3095.3
Total natural gas consumption (Kiln Dried 10^{12} J)	2833.5	2614.7	5724.9
Total sector energy consumption 10^{12} J	5387.8	5126.4	8820.2

Improvement (1985 base year) = –5.1%

Improvement (1978 base year) = 38.9%

Reporting Companies

Chemical

Alberta Gas Chemicals Ltd.
Alby Chlorates Canada Inc.
Ashland Chemicals
Atkemix Inc.
BASF Canada Inc.
Blachford, H.L., Ltd./Ltée
Borden Chemical
British Columbia Chemicals Ltd.
Carlew Inc.
Celanese Canada Inc.
Commercial Alcohols Limited
Cyanamid Canada Inc.
Dominion Colour Company
Domtar Chemicals Group
Dow Chemical Canada Inc.
Du Pont Canada Inc.
Esso Chemical Canada
Ethyl Canada Inc.
General Chemical Canada Ltd.
Goodrich, B.F., Canada Inc.
Hart Chemical Limited
Henkel Canada Ltd.
Himont Canada Inc.
Hoechst Canada Inc.
Huls Canada Inc.
Lubrizol Canada Limited
Monsanto Canada Inc.
Nacan Products Limited
National Silicates Limited
Nitrochem Inc.
NL Chem Canada Inc.
Novacor Chemicals Ltd.
Ocelot Ammonia Company
Pétromont Inc.
Pigment & Chemical Inc.
Polysar Limited
Quantum Chemical Ltd., Emery Division
QuéNord Inc.
Reed Inc.
Rohm & Haas Canada Inc.
Shell Canada Chemical Company
Sulco Chemicals Limited
Surpass Chemicals Limited
Tioxide Canada Inc.
Union Carbide Canada Limited
Uniroyal Chemical

Electrical and Electronic

Alcan Wire and Cable
Andrew Antenna Co. Ltd.
Arcan Canada
Ascolectric Ltd.
ASEA Inc.
Brown Boveri Canada Inc.
Black & Decker Canada Inc.
B.B. Howden Inc.
Burndy Inc.
Camco Inc.
Canada Wire and Cable Limited
Commander Electrical Materials Inc.
Commander Electrical Equipment Inc.
Crouse-Hinds Electrical Construction Materials
Eaton Yale Ltd.
Edwards, a Unit of General Signal Ltd.
Federal Pioneer Limited
Garrett Canada
General Electric Canada Inc.
General Wire & Cable
Gennum Corporation
Gould Electronics Canada
Gould Shawmut Company
GTE Sylvania Canada Ltd.
Honeywell Limited
Hoover Canada Inc.
Inglis Limited
Iona Appliances Inc.
ITT Cannon Canada
Lincoln Electric Co. of Canada Ltd.
Manville Canada Inc.
Marine Industrie Limitée
Moloney Electric Corporation
Motorola Information Systems
NEI Ferranti-Packard Electronics Ltd.
Phillips Cables Limited
RCA Inc.
Sangamo Canada
Siemens Electric Limited
Spar Aerospace Limited
Texas Instruments Canada Limited
Trench Electric
Westinghouse Canada Limited
WCI Canada Inc.
3M Canada Inc.

Ferrous Metals

Algoma Steel Corporation
Dofasco Inc.
Sidbec-Dosco Inc.
Stelco Inc.
Sydney Steel Corporation (Sysco)

Food and Beverage

Association of Canadian Biscuit Manufacturers

Christie Brown Ltd.
Colonial Cookies Ltd.
Culinar Inc.
Dare Foods Limited
InterBake Foods Limited
Manning Biscuits Ltd.

Association of Canadian Distillers

Alberta Distillers Limited
Andrés Wines Ltd.
Canadian Mist Distillers Limited
Corby Distilleries Ltd.
FBM Distillery Co. Limited
Gilbey Canada Inc.
Gooderham & Worts
Hiram Walker & Sons Limited
McGuinness Distillers Limited
Palliser Distillers Limited
Schenley Canada Inc.
Seagram, Joseph E., & Sons, Limited

Bakery Council of Canada

Ben's Limited
Corporate Foods Limited
Eastern Bakeries Limited
McGavin Foods Limited
Multi-Marques Inc.
Weston Bakeries Limited

Brewers Association of Canada

Carling O'Keefe Breweries
Labatt Brewing Company Limited
Molson Breweries of Canada Limited
Moosehead Breweries Limited
Northern Breweries Ltd.
Pacific Western Brewing Co. Ltd.
The Ottawa Valley Brewing Co. Ltd.
Upper Canada Brewing Co. Ltd.

Canadian Food Processors Association

Campbell Soup Company Ltd.
Canadian Canners Limited
Heinz, H.J., Company of Canada, Ltd.
Hunt-Wesson Canada Ltd.
Kraft Limited
Libby, McNeill & Libby Inc.
Lord, David Limitée
Morrison Lamothe Frozen Foods Ltd.
Produce Processors Limited
Royal City Foods Ltd.
Smith, E.D., & Sons Limited
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Thomas Canning (Maidstone) Ltd.

Canadian Meat Council

Burns Meats Limited
Canada Packers Inc.
Export Packers Inc.
Fearman, F.W., Company Ltd.
Intercontinental Packers Ltd.
Piller Sausages & Delicatessens Ltd.
Quality Meat Packers Ltd.
Schneider, J.M. Inc.
Supreme Packers Inc.
Vancouver Fancy Meats Co. Ltd.

Canadian Poultry and Egg Processors Council

A.C.A. Co-operative Association Ltd.
Bexel-Division de la Co-op. Fédérée de Québec
Canada Packers Inc.
Co-op Dorchester Ltée
Lashbrook Produce Limited
Lilydale Co-op Limited
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Leaf Mills Limited
Maple Lynn Foods Ltd.
Tend-R-Fresh Poultry Products Ltd.
P & H Foods Ltd.
Volco Limited

Canadian Soft Drink Association

Beverage Services Ltd.
Blackwoods Beverages Ltd. (Calgary)
Blackwoods Beverages Ltd. (Winnipeg)
Canada Dry Ltd.
Cassidy's Beverages Limited
Coulombe Québec Limitée
Désormeaux, S., Inc.
Gray Beverage Company Ltd.
Gray Beverages (Alberta) Ltd.
Gray Beverages (Island) Co.
H.P.I. Beverages Ltd.
Ideal Sport Inc.
Kitchener Beverages Ltd.
Larrivée et Frères Inc.
Liqueurs Saguenay Ltd.
Maedel's Beverages Ltd.
Maritime Beverages Ltd.
Misener Beverages Ltd.
Pathfinder Beverages Ltd.
Pepsi/Seven-Up Bottling of Toronto Ltd.
Saskal Beverages Ltd.
Seven-Up (Saskatoon) Ltd.
Seven-Up (Valleyfield) Ltée
Simard, Philippe, & Fils Ltée
Starlite Bottlers Ltd.
Swift Current Bottlers Ltd.
T.C.C. Bottling (Calgary) Ltd.
T.C.C. Bottling (Edmonton) Ltd.
T.C.C. Bottling (St-Paul) Ltd.

Canadian Sugar Institute

British Columbia Sugar Refining Company Limited
Lantic Sugar Limited
Redpath Sugars Limited
St. Lawrence Sugar Division Natalik Inc.
Westcane Sugar Limited

Confectionery Manufacturers of Canada

Adams Brands Inc.
Dare Foods Limited
Hershey Canada (Montréal) Inc.
Hershey Canada (Smith Falls) Inc.
Laura Secord Inc.
Leaf Confections Ltd.
Neilson, William, Ltd./Ltée
Rowntree, Mackintosh Canada Ltd.
Wrigley Canada Inc.

Fisheries Council of Canada

British Columbia Packers Limited
Connor Bros. Limited
National Sea Products Limited
Omstead Foods Limited

Grocery Products Manufacturers of Canada

Binet & Turgeon Ltée
Catelli Inc.
Culinar Inc.
General Foods Inc.
Gerber (Canada) Inc.
Jacobs Suchard Canada Inc.
Lancia Bravo Foods Limited
Lipton, Thomas J., Inc.
Monarch Fine Foods
Nabisco Brands Ltd.
Nabisco (Canned Goods) Ltd.
Nabisco Food Services

Starch Council of Canada

Casco Limited
Nacan Products Ltd.
Ogilvie Mills Ltd.
St. Lawrence Starch Co. Ltd.

General Manufacturing

Rubber Products

Gates Canada Inc.
General Tire Canada Limited
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal Goodrich Canada Ltd.

Chemical, Pharmaceutical and Medical Products

Canadian Occidental Petroleum Limited
Glaxo Canada Inc.
Johnson & Johnson Inc.
Merck Frosst Canada Inc.
Tambrans Canada Inc.
Pratt & Lambert Inc.
Valspar Chemicals Ltd.

Foundries, Forgings and Heavy Metal Processors

Aciers Slater
Brass Craft Canada Limited
Brown Foundry Ltd.
Canada Forgings Inc.
Canada Metal Company Limited
Canadian Bronze Company Limited
Canron Inc.
Canvil Ltd.
Darling Duro Limited
Esco Ltd.
Fonderie Magotteaux Canada Ltée
Gray Forgings & Stampings Limited
Huron Steel Products (Windsor) Ltd.
Lake Ontario Steel Company Limited
Manville Canada Inc.
Metals & Alloys Company Limited

Light Manufacturing

American Standard Inc.
Annapolis Valley Peat Moss Co. Ltd.
Atlantic Industries (N.B.) Ltd.
Atco Limited
Black and Decker Canada Inc.
Bombardier Inc.
Canadian General Tower Ltd.
Commercial Aluminum, Division of Indal Ltd.
Cooper Tools
Dorr-Oliver Canada Limited
GSW Water Products Company
Indal Technologies Inc.
Indalloy Ltd., Division of Indal
Ivex Corporation
Jarvis Clarke Company Limited
Kawneer Company Canada Limited
Kodak Canada Inc.
Leitz, Ernst, Canada Limited
Maclean Hunter Company Limited
NCR Canada Ltd.
Oneida Canada Limited
Paddle Valley Products Limited
RJR-MacDonald Inc.
Snap-On Tools of Canada Ltd.
SKD Manufacturing
Teledyne Canada Metal Products
Temprite Industries Ltd.
Trane Canada
W.C. Wood Limited

Industrial Minerals

Abrasives

Electro Minerals Inc.
Exolon-Esk Company of Canada Ltd.
General Abrasives Canada Limited
Norton Canada Inc.

Asbestos

Brinco Mining Ltd., Cassiar Division
Carey Canada Inc.
JM Asbestos Inc.
Lab Chrysotile Inc.

Cement

Canada Cement Lafarge Ltd.
Ciment Québec Incorporated
Federal White Cement Limited
Genstar Cement Limited
Lake Ontario Cement Limited
North Star Cement Limited
St. Lawrence Cement Inc.
St. Marys Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée
Canada Vitrified Products Limited
Estevan Brick Limited
Hamilton Brick Ltd.
I-XL Industries Ltd.
Medicine Hat Brick and Tile Ltd.
Medicine Hat Sewer Pipe Ltd.
National Sewer Pipe Limited
Northwest Brick and Tile Ltd.
Redcliff Pressed Brick Ltd.
Red River Brick and Tile

Concrete Products

Consolidated Concrete Ltd.
Con-Force Structures Limited
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Richvale Block and Ready-Mix
Redi-Mix Limited
York Block and Supply Limited

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Domglas Inc.
Fiberglas Canada Inc.
PPG Canada Inc., Glass Division

Lime

Havelock Lime Company of Canada Limited
Reiss Lime Company of Canada Limited
Summit Lime Works Limited

Miscellaneous Minerals

Indusmin Limited
Saskatchewan Minerals
Steetley Talc Inc.
3M Canada Inc.

Refractories

Green, A.P., Refractories (Canada)
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories Company Limited

Machinery

ACCO Canadian Material Handling, a Division of Dominion Chain Inc.
Beloit Canada Ltée/Ltd.
Bingham International Inc.
Boart Canada Inc.
Canadian Blower/Canada Pumps Limited
Canron Inc., Mechanical Division
Continental Conveyor & Machine Works Ltd.
Continuous Mining Systems Limited
Crane Canada Inc., Valve & Industrial Division
R.J. Cyr Co. Inc.
Dominion Engineering Works, a Division of Canadian General Electric Company Limited
Ebco Industries Ltd.
Edson Packaging Machinery Limited
FAG Bearings Ltd.
Farris Industries Canada
FMC of Canada Limited, Material Handling Operation
Greey Lightnin, Unit of General Signal Limited
Heath & Sherwood (1964) Limited
Industries USP Inc.
Ingersoll-Rand Canada Inc.
H.G. Kalish Inc.
Kockums CanCar Inc.
Motivation Industrial Equipment Ltd.
MTD Products Ltd.
Pathex International Ltd.
Provincial Crane Inc.
RMS Machinery Division, Uniroyal Goodrich Canada Inc.
Smart Turner Limited
Union Pump (Canada) Ltd.
Ward Ironworks Limited
WEMCO Canada, Division of Baker International Canada Ltd.

Mining and Metallurgy

Cominco Ltd.
Denison Mines Ltd.
Eldorado Resources Limited
Falconbridge Limited
Giant Yellowknife Mines Limited
Hudson Bay Mining and Smelting Co., Limited
Inco Limited
Iron Ore Company of Canada Ltd.
Noranda Minerals Inc.
Placer Dome Inc.
Quebec Cartier Mining Company
Rio Algom Limited
Syncrude Canada Limited

Petroleum Refining

Consumers' Co-Operative Refineries Limited
Esso Petroleum Canada
Husky Oil Products Company
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude
Texaco Canada Inc.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

Aclo Compounders Inc.
American Biltrite Canada Ltd.
Amhil Enterprises Ltd.
Atlantic Packaging Products Ltd.
Beaver Plastics Limited
Bonar Rosedale Plastics Ltd.
Canada Cup Inc.
Canadian General-Tower Ltd.
Carlew Chemicals Ltd.
Cascades Dominion Inc.
Celfortec Inc.
Chantler & Chantler Inc.
Chemacryl Plastics Limited
C-I-L Inc.
Coastal Plastics Ltd.
Daymond, a Division of Redpath Inc.
Domtar Construction Materials
Duron Plastics Ltd.
Ferro Industrial Products Limited
Fibracan Inc.
Formica Canada Inc.
F&H Plastics Ltd.
Hayden Manufacturing Co. Ltd.
IPL Inc.
I.T.W. Plastiglide
Jet Moulding Compounds Limited
Manuplast Inc.
Mattel Canada Inc.
Morbern Inc.
Norseman Plastics Limited
Pavaco Plastics Inc.
Persita Inc.
Plasti-Drain Ltée
Plax Inc.
Propak Plastics Ltd.
Polytainers Limited
Pro-Western Plastics Ltd.
Rubbermaid Canada Inc.
Sculpturethane Corp.
Spartan Plastics Canada Inc.
Uniplast Industries Inc.
Westra Inc.

Pulp and Paper

Abitibi-Price Inc.
Atlantic Packaging Products Ltd.
Armstrong World Industries Canada Ltd.
Beaver Wood Fibre Company Limited
Boise Cascade Canada Ltd.
Bowater Mersey Paper Company Limited
British Columbia Forest Products Limited
Canadian Forest Products Ltd.
Cariboo Pulp and Paper Company
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Celgar Pulp Company
Champion Forest Products (Alberta) Ltd.
CIP Inc.
Consolidated-Bathurst Inc.
Crestbrook Forest Industries Ltd.
Crown Forest Industries Limited
Domtar Inc., Pulp and Paper Products
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp and Paper Co. Ltd.
La Cie J. Ford Ltée
Fraser Inc.
Gaspesia Pulp and Paper Company Ltd.
Great Lakes Forest Products Limited
Industries James Maclaren Inc.
Irving Pulp and Paper, Limited
Island Paper Mills Limited
James River-Marathon, Ltd.
Kimberly-Clark of Canada Limited
Kruger Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power
Manfor Ltd.
Minas Basin Pulp & Power Company Limited
Miramichi Pulp & Paper Inc.
NBIP Forest Products Inc.
Northwood Pulp & Timber Limited
Paperboard Industries Corporation
Papier Cascades (Cabano) Inc.
Perkins Paper Ltd.
Procter & Gamble Inc.
Quebec and Ontario Paper Company Limited
Reed Inc.
Rolland Inc.
Rothesay Paper Limited
St. Anne-Nackawic Pulp & Paper Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Limited
Scott Paper Limited
Skeena Cellulose Inc.
Sonoco Limited
F.F. Soucy, Inc.
Spruce Falls Power & Paper Company, Limited
Stora Forest Industries
Strathcona Paper Company
Tembec Inc.
Western Pulp Limited Partnership
Weyerhaeuser Canada Inc.

Canadian Textiles Institute

Albany International Canada Inc.
Artex Woollens Limited
Asten-Hill Inc.
Badishe Canada Ltd.
Barrymore Carpet Inc.
Bell Tootal Inc.
Bermatex Inc.
H.N. Biron & Fils Inc.
Britex Ltd.
Burlington Canada Inc.
Tricots Canada U.S. Inc.
Celanese Canada Inc.
Cleyn & Tinker Inc.
C&T Modele Inc.
Coats, J.& P., (Canada) Inc.
Consoltex Inc.
Fashion Division –
- Cowansville
- Drummondville

Home Furnishings Division –
- Sherbrooke

Outerwear Division –
- Alexandria
- Montmagny
- Coaticook

Crossley Karastan Carpet Mills Ltd.
DeBall, J.L., Canada Limited
Dominion Textile Inc.
Apparel Fabrics –
- Beauharnois Finishing Plant
- Domil, Sherbrooke
- Drummondville
- Long Sault, Fabrics
- Magog

Consumer Products –
- Caldwell, Iroquois
- Sherbrooke
- Esmond, Granby
- Magog

Sales Yarn –
- Domil, Sherbrooke
- Long Sault, Yarns
- Mount Royal Dye House, Montreal

Industrial Products –
- Drummondville
- Yarmouth
- Hawkesbury
- Woodstock

Drytex, Division of JWI Ltd.
Dura Undercushions Ltd.
Les Tricots Duval & Raymond Ltée
Harding Carpets Limited
Harvey Woods Limited
Heuga Canada Limited
Huyck Canada Limited
Leedye Inc.
Newlands Textiles Inc.
Nova Scotia Textiles Ltd.
Ozite Canada (1981) Inc.
Patons & Baldwins Canada Inc.
Peeters Carpets Ltd.
Rayonese Textile Inc.
Rubyco Inc.
Rumpel Felt Company Limited
Satexil Inc. Division Texgran
Tapis Coronet Inc.
Tapis Peerless Ltée
Tapis Venture Canada Ltée
Textiles Dionne Inc.
- St. Georges de Beauce Division
- Montmagny Division
- Drummondville Division

Waterville Cellular Products Ltd.

Transport

Aerospace Industries Association of Canada

Aircraft Appliances and Equipment Limited
Bendix Avelex Inc.
B & M Helicopters
CAE Industries Ltd.
Canadair Limited
Canadian Marconi Company
Chicopee Manufacturing Limited
Computing Devices Company
Field Aviation East Ltd.
Garrett Canada
Haley Industries Ltd.
Indal Technologies Inc.
Litton Systems Canada Limited
Lucas Industries Canada Limited
McDonnell Douglas Canada Limited
MEL Defence Systems
Pratt & Whitney Canada Inc.
Raytheon Canada Limited
Rockwell International of Canada Ltd.
Rolls-Royce (Canada) Limited
Spar Aerospace Limited
Unisys Canada Inc.

Automotive Parts Manufacturers' Association

Algoods, Division of Aluminum Company of Canada Ltd.
B & W Heat Treating (1975) Limited
Beckers Lay-Tech Inc.
Bendix Engineering (Can.Fram)
Blackstone Industrial Products Limited
Budd Canada Inc.
CAE Accurcast
Canada Forging Inc.
Champion Spark Plugs Co. of Canada Inc.
Daymond, a Division of Redpath Industries Limited
FAG Bearings Ltd.
Fahramet Steel Castings
Galtaco Inc.
Goodyear Canada Inc.
Hayes-Dana Inc.
Hoover Universal of Canada
Kelsey-Hayes Canada Limited
Mastico Industries Ltd.
Metals & Alloys Company Limited
MTD Products Limited
Duplate (PPG)
Reynolds Aluminum Company of Canada Ltd.
SKD Company
Slater Steel Corporation
Stemco Canada
Thomson Rivet Co. Limited
Thyssen Marathon Canada Ltd./Ltée
TRW Canada Limited

Canadian Shipbuilding and Ship Repairing Association

Marine Industrie Limitée
Marystown Shipyard Ltd.
MIL Davie Inc.

Canadian Truck and Trailer Manufacturers' Association

The Trailmobile Group of Companies Ltd.

Motor Vehicle Manufacturers' Association

Chrysler Canada Ltd.
Ford Motor Company of Canada Limited
General Motors of Canada Limited
Navistar International Corporation Canada

Wood Products (Western)

Balfour Forest Products Inc.
Canadian Forest Products Limited
CIP Inc., Tahsis Pacific Region
Crestbrook Forest Industries Ltd.
Crown Forest Industries Ltd.
Eurocan Pulp & Paper Co.
Evans Products Co. Ltd.
Federated Co-Operatives Ltd.
Finlay Forest Industries Ltd.
Groot, D., Logging Ltd.
Groot Lumber Ltd.
International Forest Products
MacMillan Bloedel Ltd.
Nechako Lumber Co. Ltd.
Northwood Pulp & Timber Ltd.
The Pas Lumber Company Ltd.
Primex Forest Products
Quesnel Forest Products
Riverside Forest Products Ltd.
Stuart Lake Lumber Co. Ltd.
Weldwood of Canada Limited
Zeidler Forest Industries Ltd.

Appendix A

Reporting Methodology

The objective of the CIPEC monitoring system is to track as closely as possible the actual changes in production energy intensity. Performance monitoring procedures and accounting methodology used by the task forces follow a prescribed aggregating method established by CIPEC in 1975.

The basis of the CIPEC method is to compare energy consumption to physical units of production, where possible. This is done by determining the difference in current year and base year energy-intensities, which is the same as a comparison of the current year consumption to the energy–that would have been used in a base year (at the same level of production) before any efficiency improvements had taken effect.

The original 1972 base year was gradually modified as new companies joined the program and participating companies introduced new products. These changes resulted in a consolidated base year of 1973.

After more than a decade of CIPEC monitoring, most task forces updated individual reference years to 1985 to recognize the many fundamental changes that have occurred since the beginning of the program. Reporting of future performances will carry forward the past achievements, however, to retain the long-term trends in performance.

The quantity of energy savings claimed is calculated as the difference between the total current year energy consumption and the base year equivalent energy consumption. Each year the base year equivalent energy consumption is determined by aggregating the results of each participating company. This method of determining changes in energy-intensities thus incorporates the total effects of changes in production-mix, production volumes, technologies, and energy conservation activities.

Feedstocks used in the Chemical and Petroleum Refining industries are not included in the task force or CIPEC accounting system since conservation of these commodities is not an issue. However, process improvements which register as site throughput reductions are regarded as conservation of energy. In the Ferrous Metal industry, the metallurgical coal that is used to make coke for steel manufacture is treated as a primary fuel input.

Since reporting began, it has been necessary to apply minor adjustments to the consumption numbers to normalize the impact of fluctuations in weather, added energy consumption from imposed environmental equipment and periodic changes in raw material quality. These corrections are done at the individual company level which often reports both gross and net efficiencies. This practice will be continued to allow participants to make future adjustments where necessary.

Appendix B

Conversion Factors

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3413 BTU/kWh
– gross	10.551 MJ/kWh	10000 BTU/kWh
Natural Gas	37.2 MJ/m^3	1.00 x 10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145 x 10^6 BTU/IG
Crude Oil	38.5 MJ/litre	5.8 x 10^6 BTU/bbl
Distillate Oil	39.0 MJ/litre	0.168 x 10^6 BTU/IG
Residual Oil (2.5%S)	42.3 MJ/litre	0.182 x 10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6 x 10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0 x 10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0 x 10^6 BTU/ton
Coke-Petroleum-Raw	23.3 GJ/tonne	20.0 x 10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156 x 10^6 BTU/IG
Diesel Fuel	39.9 MJ/litre	0.172 x 10^6 BTU/IG
Kerosene	38.8 MJ/litre	0.167 x 10^6 BTU/IG
LPG	27.1 MJ/litre	0.117 x 10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

Photos

	Captions	Courtesy
iv	Heat Pump Installation	Ontario Hydro
14	Maitland Plant	DuPont Canada Inc.
18	Large Power Transformer	Westinghouse Canada Inc.
22	Tilting Furnace	Algoma Steel Corp.
24	Continuous Casting Control Room	Stelco Inc.
26	Control Room	Moosehead Breweries Ltd.
32	Construction of Subway Cars	Bombardier Inc.
35	Foundry Operation	Ford Motor Company
38	Float Glass Line	AFG Glass Inc.
44	Overhead Crane Construction	John T. Hepburn Ltd.
46	Gas Turbine Assembly	Westinghouse Canada Inc.
48	Mine Site	Quebec Cartier Mining Co.
52	Refinery Control Room Panel	Imperial Oil Ltd.
56	Thermoforming Operation	Kerwill Publications
60	Shipping Room	British Columbia Forest Products Ltd.
64	Dyeing Room	Celanese Canada Inc.
68	Body Assembly	Chrysler Canada Ltd.
72	Logging	Ministry of Industry, Science and Technology
74	Wood Storage	Ministry of Industry, Science and Technology
76	Electric Pylons	

The information, perspectives and data reported herein are solely the responsibility of the Canadian Industry Program for Energy Conservation Council and the reporting task forces.

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Energy, Mines and Resources Canada

Énergie, Mines et Ressources Canada

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